3 Socio-Economic Benefits

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3.1 Introduction

GMEP undertakes a range of activities to capture the wider socio-economic benefits of the Glastir scheme. These benefits may arise from a range of Glastir activities including payments from farmers into the local community for labour or services to more indirect pathways such as an improved visual landscape quality which has the potential to benefit both local communities and the tourism industry. More generally it is hoped the greater protection of our natural resources intended from Glastir payments will contribute to the 'Resilient Wales' Goal of the Well-being and Future Generations Bill.

Activities in this area in Year 2 have included:

- An assessment of the benefits of the Glastir Efficiency Grants to the wider community and the potential impacts on farm carbon footprints;
- Understanding the barriers to uptake of the Woodland Creation Scheme
- Developing objective, transparent and repeatable measures for assessing the visual landscape quality to enable the impact of Glastir to be assessed in the future
- Quantifying accessibility the landscape both in terms of physical accessibility through the Public Rights of Way network (PROW) and a derived measure of visual accessibility which takes account of the view as experienced by the public within the landscape.
- Continued assessment of the condition of the historic assets present such that future impacts of Glastir can be assessed.

3.2 Major achievements in Year 2

- We planned the approach for assessing the impact of Glastir Efficiency grants on i) the carbon footprint of farms which have made use of them, and ii) the wider (off-farm) benefits to the rural economy
- A GMEP Visual Quality Index (VQI) has now been successfully run on the 150 1st and 2nd year GMEP 1km survey squares. This has generated a data listing all of the 23 input parameters by square and weighted index values for each. Each of the survey squares has now been ranked from 1 (highest quality index) to 150 (lowest quality index).
- Viewshed analysis has been completed at 3 scales for 150 1st and 2nd year 1km survey squares using 4 different categories of users (pedestrians, cyclists, small vehicle users, rail users) for 3 different scales: looking within the GMEP 1km survey square, looking out to the surrounding 3 x 3 km, looking in from the surrounding 3 x 3 km square. This equates to 1800 separate viewshed datasets for the two years.
- Condition assessment data collected for the historic environment features of the 150 1st and 2nd year GMEP 1km survey squares.
- Number and condition of Public Rights of Ways in the Year 2 GMEP 1km survey squares have been assessed.
- Photographic preference survey pilot undertaken early spring 2014, the online survey was then refined and launched summer 2014 with both English and Welsh versions available. Currently, over 1360 surveys have been completed online with approximately 10% of these completed in Welsh. The PPS has validated the VQI ranking process and has provided further information about the positive and negative impacts of specific components of the VQI. Our initial target was 500 completed surveys, so this has exceeded our expectations significantly and has generated a dataset of wider significance and value.

3.3 Key Findings in year 2

3.3.1 Wider Socio-Economic Effects of Glastir Efficiency Scheme Grants

More than 90% of respondents agreed that Glastir Efficiency Grants (GEGs) had encouraged them to undertake new capital investments. Similarly, the majority of farmers (83%) agreed that access to GEGs increased their scale of planned investment. Over 87% of farmers agreed that their funded project would not have happened without the grant, suggesting that GEGs has provided a useful tool for delivering economic development and encouraging new on-farm initiatives.

Increased farm expenditure was spent within Welsh industries (68%), Welsh households (18%) and taxes (8%) with the remaining 6% unaccounted for due to respondent survey error. Of the expenditure that respondents allocated to imported materials, the majority was for building materials (49%), and machinery and equipment (32%). Of these imports, 57% of spending was within the UK and Ireland; 8% reported a mixture of spending throughout the UK and European countries and 13% imported products from other European countries.

According to 71% of respondents, GEGs grants have promoted a beneficial effect on farm suppliers across all farm types. Similarly, 44% of respondents stated that farm customers and clients had experienced beneficial financial effects from the grants.

3.3.2 Understanding Barriers to Uptake of Woodland Creation Schemes

Results indicated that the process is perceived to undermine the scheme objectives and acts as a disincentive for potential scheme members from both the farming community and the Local Authorities. Recommendations to improve uptake include:

- To achieve greater scheme uptake the application process should be simplified.
- The scheme needs to be more flexible to account for external influences.
- The auditing process needs to be less threatening, and penalties need to be clearly communicated to encourage greater uptake.
- Payment rates need to be clarified to encourage potential members to adopt the scheme.

3.3.3 The range of VQI across the Welsh landscape

- There is no significant difference in VQI between upland and lowland sites. However, the upland landscapes have a smaller range of VQI values and a higher overall median value which indicates that they tend not to include the lowest quality landscapes. It is only where a range of positive values coincide that very high landscape quality scores prevail.
- There is no statistical difference between the mean quality ratings assigned to the GMEP 1km survey square which fall within / without of a protected area. However, there are clear differences in the range of values, with all the highest values falling into protected areas.
- No relationship is shown between the landscape quality rating and the number of plant, bird, butterfly or bee species was present in the GMEP Year 1 and 2 1km survey squares suggesting there is no direct relationship between ecological and landscape quality as indicated by these initial test metrics. A more systematic and integrated approach, e.g. using the High Nature Value Farmland index currently under development, will be assessed in future years which will also benefit from a greater sample size.
- Sites which contained areas of Glastir land were compared against those with none. Although there was some indication that those sites with higher VQI values were found within the Glastir managed scheme, the results were not significant to date. Again as more squares are surveyed this trend may become clearer. A photographic preference survey undertaken by over 2600 people identified surprisingly few differences between people's preference for landscapes depending on gender, age, nationality, type of location of birth or current home.

3.3.4 Access

Of the GMEP first and second year sites, the digital data show that 133 of the 150 contained some Public Rights of Way. Two-thirds of the paths on a 1km site were fully open, physically accessible and easy to find. For the remainder, poor signage was common and many footpaths were infrequently used as a consequence which led to degradation and poor maintenance.

3.3.5 Condition of historic features

Within the 150 GMEP 1km survey squares of the first and second year survey, it has been possible to survey around 120 historic features. The most common types of feature were buildings (including houses and cottages), ponds and quarries. An assessment of condition shows that 8% were judged to be in excellent condition at the time of survey and 35% were seen to be sound with minor defects. However, 33% were assessed to be showing major signs of deterioration while a further 7% were seen to have significant damage. Vegetation was the most prevalent threat.
These findings are outlined in more detail below structured by activity.

3.4 Wider Socio-Economic Effects of Glastir Efficiency Scheme Grants

Grants are available to farmers via the Glastir Efficiency Scheme (GES), previously known as the Agricultural Carbon Reduction and Efficiency Scheme (ACRES). The GES provides grants to farmers and land managers to improve farm management, particularly to improve Slurry and Manure Efficiency (SME), Energy Efficiency (EE) and Water Efficiency options (WE). Through these grants, GES aims to reduce greenhouse gas emissions from the agriculture sector, and in particular, the dairy sector. As part of the GMEP project, we have evaluated what grants have been spent on, as well as the socio-economic impact of the scheme at a regional scale. In 2013, a questionnaire was designed and used to collate information from farmers who had been successful with GES applications. There is interest within the Welsh Government to identify the wider benefits of Glastir beyond the landowner in receipt of the payment. A survey was carried out to explore the wider benefits of the Glastir Efficiency Grants as a case study to explore this issue.

3.4.1 Methods

Questionnaires were completed by 120 farmers whose applications for a Glastir Efficiency Scheme grant had been approved. Information was collected about what the grant had been used for, where the money had been spent, the effects the grant had had on labour, as well collecting farm characteristics.

We also evaluated the potential efficacy of the Glastir Efficiency Scheme for reducing carbon emissions across the Welsh livestock sector. The primary aims of this evaluation were to: i) Provide an average baseline carbon footprint for a representative cross-section of GES-participating farms, ii) Evaluate the potential within the Welsh agricultural sector for reducing GHG emissions through application of GES-funded technologies, and iii) Identify key aspects of farm footprints which may facilitate or inhibit the success of the Glastir Efficiency Scheme. To achieve this, twenty farms (of those farms that had been successful with GES applications) were contacted by project officers and interviewed face to face. A questionnaire was used as a script for obtaining the necessary information for input into the Bangor Carbon Footprinting Tool. Since insufficient time had passed for any of the GES grants to have been fully implemented on-farm, farmers were asked to provide information representing one ‘typical’ business year within the period 2011 to 2013, to act as a baseline carbon footprint for future comparison.

3.4.2 Results

3.4.2.1 Grant Allocation (what have grants been spent on)

Of the 120 completed surveys, 59% of respondents farmed on LFA cattle and sheep farms, a further 30% on dairy farms, 7% of farms were described as ‘other’ consisting of various main farm types and

3% of farms did not specify. A total of 305 grants were approved for farms in the survey. Energy efficiency grants accounted for 9.2% of total approved grants, of which 7.9% were assigned to dairy farms, 1.3% to 'other' farms and none to LFA cattle and sheep. Grants awarded to LFA cattle and sheep farms were nearly all for slurry and manure efficiency (174 of the 179 approved grants). The total monetary value of the paid grants amounted to ca. £1 Million by the end of 2013. No water efficiency grants were in progress. Slurry and Manure Efficiency grants accounted for nearly 90% of the spend, with Energy Efficiency grants representing the remainder. Lowland dairy farms received the largest grant per farm (on average ca. £16,000), compared to average grants of between £8000 - £10,000 for LFA farms (cattle and sheep, and dairy).

A wider benefit of some of the Slurry and Manure Efficiency grants is the reduction in ammonia emissions that will result. Livestock manure is a key source of ammonia volatilisation from livestock systems, and represents an agronomic loss of nitrogen that would otherwise be recycled to land for grass and crop growth.

3.4.2.2 Wider Economic Effects of GES Grants

More than half of respondents reported the grants made no impact on all but two sectors of farm expenditure. Fertiliser annual expenditure was positively affected by the grants on 75% of farms (Figure 3.4.2.2.1). Labour expenditure was positively impacted in 50% of cases and contractor expenditure in 40% of cases. Negative impacts were reported by a minority of farmers (2-7%, depending on sector), with the largest negative impacts on contractors and building materials expenditures (6.7% of respondents in both cases), while the least frequently reported negative impact was for veterinary fees (1.7%).

More than 90% of respondents agreed that GES had encouraged them to undertake new capital investments. Similarly, the majority of farmers (83%) agreed that access to GES increased their scale of planned investment. Over 87% of farmers agreed that their funded project would not have happened without the grant. This suggests that GES has provided a useful tool for delivering economic development and encouraging new developments.

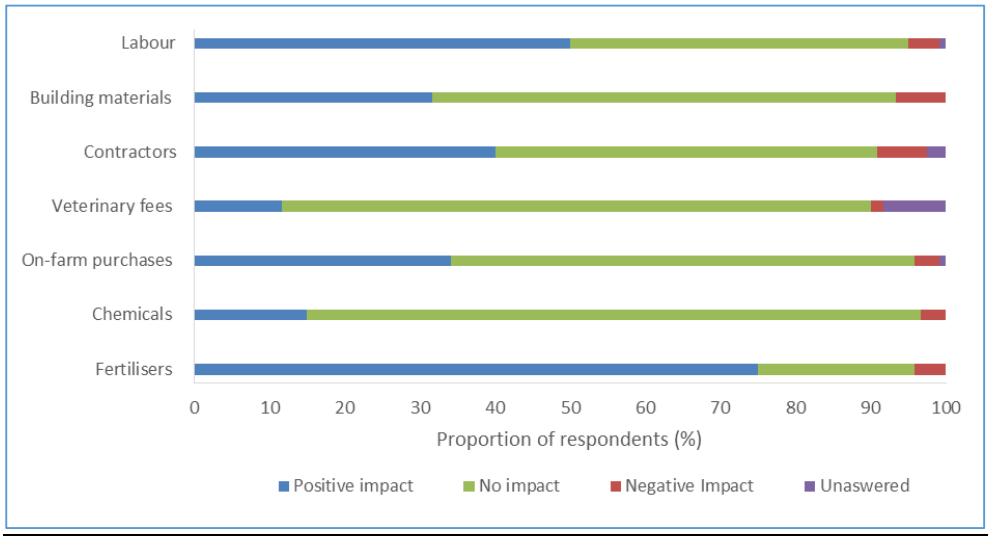


Figure 3.4.2.2.1 *Respondents' perception of grant impact on different sectors of on-farm expenditure.*

3.4.2.3 Where is Glastir Efficiency Scheme Grant Money Spent?

The increased expenditure provided by the grants was distributed primarily to Welsh industries (68%), with smaller quantities of money to Welsh households (18%), taxes and imports (9%; Figure 3.4.2.3.1). The majority of spending allocated to imports was for building materials (49%), and

machinery and equipment (32%). Of the expenditure allocated to imports, 57% of farms' spent within the UK and Ireland; 8% reported a mixture of spending throughout the UK and European countries and 13% only imported products from other European countries.

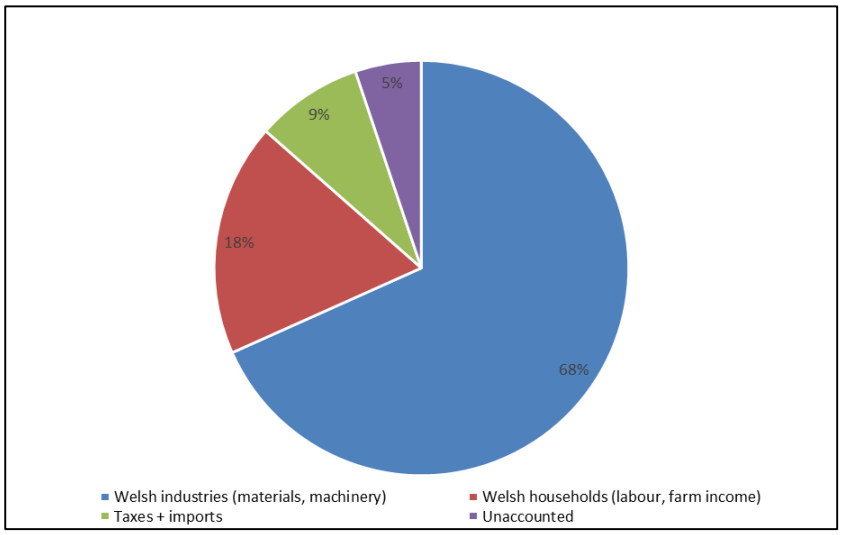


Figure 3.4.2.3.1 *Allocation of increased expenditure following receipt of GES grants.*

It is clear that the majority of the Glastir Efficiency Scheme grant money has been spent in Wales, with Welsh Industries and using Welsh labour, thus benefiting Welsh businesses and rural communities.

A comprehensive report on the wider socio-economic effects of Glastir Efficiency Scheme grants can be found as Appendix 3.3.

3.4.2.4 Effects of Glastir Efficiency Grants on Farm Carbon Footprints

The average estimated PAS-compliant footprint per hectare across all farms was 10,236.0 kg CO_2eq/ha/yr, and ranged from 2,385.1 kg CO_2eq /ha/yr to 18,987.2 kg CO_2eq /ha/yr. The average footprint per hectare on dairy farms (14,032.9 kg CO_2eq /ha/yr) was almost double that of LFA cattle and sheep farms (7,704.8 kg CO_2eq /ha/yr). Smaller farms (11,654.3 kg CO_2eq /ha/yr) averaged a higher footprint per ha of land than larger farms (7,602.0 kg CO_2eq /ha/yr).

The footprint of lamb for slaughter varied from 7.1 kg CO_2eq /kg LW to 29.0 kg CO_2eq /kg LW, and those for wool ranged from 2.8 kg CO_2eq /kg to 21.3 kg CO_2eq /kg. Dairy farms had a lower average footprint per kg lamb and wool than LFA cattle and sheep farms. Footprints for milk production per kg product ranged from 1.0 kg CO_2eq /kg for farms 50 to 199.9 ha in size to 2.2 kg CO_2eq /kg for farms > 200 ha in size.

The largest proportion of total emissions from all farms came from methane (CH_4) accounting for, on average 46.7% of emissions per ha. Methane emission rates correspond to the number of ruminant livestock, and were primarily a function of ruminant livestock enteric (gut) fermentation. Nitrous oxide (N_2O) accounted for, on average 24.5% of emissions. This was largely from direct emissions (from soil management, peaty soils, and manure handling) with the remainder coming from indirect emissions (N deposition, leaching and runoff on soils, and volatilisation from stored manure). Emissions from inputs averaged 27.6% of emissions per ha and were dominated by mineral N fertiliser, feed concentrates, and bought-in stock. The CO_2 footprint from liming was small on all farms, ranging from 0.5 kg C CO_2eq /ha/yr to 3.9 kg CO_2eq /ha/yr.

Very few statistically significant associations were found between footprints of livestock and farm size, stock numbers in winter and summer, or peat soils. Farm types could not be compared statistically due to small farm sample sizes within each typology.

Carbon sequestration ranged from 520.7 to 1,648.4 kg CO_2eq /ha/yr (averaging 1,026.2 kg CO_2eq /ha/yr). Most sequestration (average 80.2%, range 46.6-100%) was in the form of carbon storage in grassland soils. Woodland contributed on average 13.2% (ranging from a net carbon loss of 4.7% to a net carbon gain of 34.4% of whole farm sequestration). Isolated trees sequestered on average 4.8% (range, 0.5% to 21.1%), and hedges 6.6% (range, 0.4 to 25.6%). Farm type and size had a negligible effect on total sequestration per hectare.

The average carbon balance (total footprint minus sequestration) of the twenty farms was 9,209.7 kg CO_2eq ha/yr, varying from 1,102.6 to 17,913.2 kg CO_2eq /ha/yr. Sequestration accounted for an average of 15.1% of the emissions footprint, but this varied widely between 4.4% and 59.9% of farm emissions. None of the farms sequestered more carbon per hectare than their total footprint.

A detailed report of the *Evaluation of the potential efficacy of Glastir Efficiency Scheme for reducing carbon emissions across the Welsh livestock sector* can be found as Appendix 3.2.

3.4.3 Summary

- There is interest within the Welsh Government to identify the wider benefits of Glastir beyond the landowner in receipt of the payment. A survey was carried out to explore the wider benefits of the Glastir Efficiency Grants as a case study to explore this issue.
- A total of 305 grants were approved for farms in the survey (July 2014). Energy Efficiency grants accounted for 9.2% of total approved grants, 7.9% were assigned to dairy farms, 1.3% to 'other' farms and none to LFA cattle and sheep. Grants awarded to LFA cattle and sheep farms were nearly all for Slurry and Manure Efficiency (174 of the 179 approved grants).
- The total monetary value of the paid grants amounted to £1,006,490. No Water Efficiency grants were in progress by July 2014. Slurry and Manure Efficiency grants accounted for £883,000, and Energy Efficiency grants, £123,490.
- Lowland dairy farms received the largest grant per farm on average (£16,102), compared to £9,855 for LFA cattle and sheep farms and £8,732 for LFA dairy farms. The smallest size category of farms (0-19.9 ha) received the smallest average grant of £8,370.
- More than 90% of respondents agreed that Glastir Efficiency Grants (GEGs) had encouraged them to undertake new capital investments. Similarly, the majority of farmers (83%) agreed that access to GEGs increased their scale of planned investment. Over 87% of farmers agreed that their funded project would not have happened without the grant, suggesting that GEGs has provided a useful tool for delivering economic development and encouraging new on-farm initiatives.
- As a consequence of the GEGs grants more than a quarter (28%) of farm businesses reported a general increase in sales with 51% reporting an increase in sales from farming specifically.
- Increased farm expenditure was spent within Welsh industries (68%), Welsh households (18%) and taxes (8%) with the remaining 6% unaccounted for due to respondent survey error (Figure 3.4.3.1).
- Of the expenditure that respondents allocated to imported materials, the majority was for building materials (49%), and machinery and equipment (32%). Of these imports, 57% of spending was within the UK and Ireland; 8% reported a mixture of spending throughout the UK and European countries and 13% imported products from other European countries.

- According to 71% of respondents, GEGs grants have promoted a beneficial effect on farm suppliers across all farm types. Similarly, 44% of respondents stated that farm customers and clients had experienced beneficial financial effects from the grants.

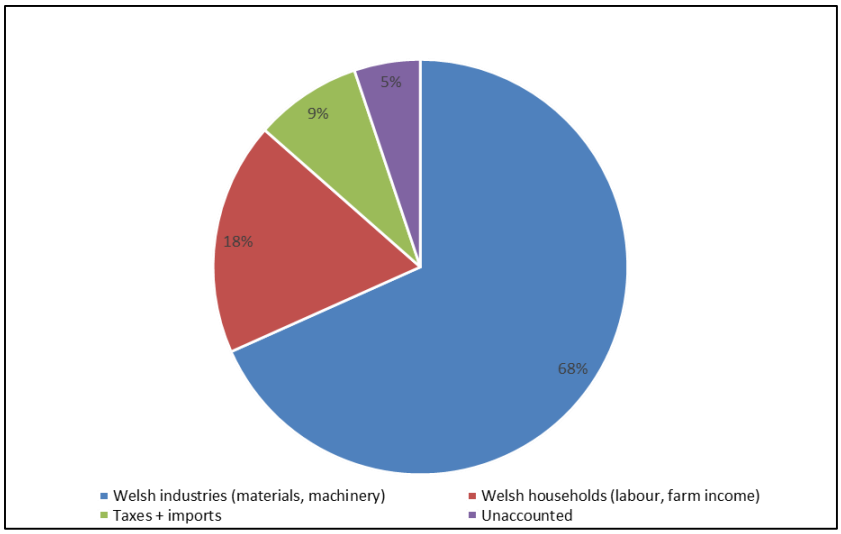


Figure 3.4.3.1 *Allocation of increased expenditure following receipt of GES grants.*

3.4.4 Potential Effects of Glastir Efficiency Scheme Grants on Farm Carbon Footprints

- Insufficient time had passed for farmers to implement GEGs grants on their farms to assess their effect on carbon footprints. Instead, this initial survey was used to establish a baseline year from which to compare carbon footprints after GEGs grants have been completed,
- The average estimated footprint per hectare across all farms was 10,236.0 kg CO_2eq/ha/yr, and ranged from 2,385.1 kg CO_2eq /ha/yr to 18,987.2 kg CO_2eq /ha/yr.
- The average footprint per hectare on dairy farms (14,032.9 kg CO_2eq /ha/yr) was almost double that of LFA cattle and sheep farms (7,704.8 kg CO_2eq /ha/yr).
- Smaller farms (11,654.3 kg CO_2eq /ha/yr) averaged a higher footprint per ha of land than larger farms (7,602.0 kg CO_2eq /ha/yr).
- Based on this study recommendations include:
    - Carbon footprinting to be repeated on the current sample of farms, at an appropriate point in time after construction and use of GES-funded capital items. This will allow a comparison between baseline emissions and emissions post-implementation, acting as an impact indicator of the scheme.
    - Prioritisation of further grant allocation to the dairy sector, subject to feasibility.
    - Prioritisation of further grant allocation in the SME category.
    - Avoid allocating soil aeration grants to farms where aeration would be conducted on peat soils.
    - Assessment of the impact of GES on ammonia volatilisation, as this is likely to be an important environmental and human health benefit of implementing some SME technologies.
    - The statistical trends in data illustrated in this report should be interpreted with caution, as the number of farms sampled within each category was too small to draw robust conclusions.

3.4.5 Recommendations

On the basis of this study's findings, we recommend the following:

- Carbon footprinting to be repeated on the current sample of farms, at an appropriate point in time after construction and use of GES-funded capital items. This will allow a comparison between baseline emissions and emissions post-implementation, acting as an impact indicator of the scheme.
- Prioritisation of further grant allocation to the dairy sector, subject to feasibility.
- Prioritisation of further grant allocation in the SME category.
- Avoid allocating soil aeration grants to farms where aeration would be conducted on peat soils.
- Assessment of the impact of GES on ammonia volatilisation, as this is likely to be an important environmental and human health benefit of implementing some SME technologies.
- The statistical trends in data illustrated in this report should be interpreted with caution, as the number of farms sampled within each category were too small to draw any robust conclusions from.

3.5 Understanding Barriers to Uptake of Woodland Creation Schemes

Woodlands provide a multitude of benefits, so WG wishes to significantly increase the area of woodland (by >30%) by 2030. Hence the Glastir Woodland Creation (WC) scheme and Woodland Management (WM) scheme were introduced to provide financial incentives to encourage more woodland planting by farmers in Wales. Both schemes sit within the wider Glastir Environmental Stewardship scheme, although the WC and WM are available to all farmers, i.e. there is no requirement to be part of the Glastir scheme.
Uptake of the Glastir WC and WM elements has been lower than expected triggering a concern that the ambitious Welsh Government target of increasing the woodland area by >30% by 2030 might not be met. Previous research indicates that there are a number of barriers for farmers (key landowners in Wales) in terms of creating woodlands including: conflict between the land required for food production and that for woodland creation, and a perceived division between the skills and knowledge required to manage agricultural land and forests, as well as economic disincentives.

3.5.1 Methods

As part of the GMEP project we set up four workshops with farmers (in Bangor, Wrexham, Newtown and Abergavenny), and interviewed staff in 14 Local Authorities to better understand the farmers' and Coed Cymru officers in Local Authorities perceptions of the challenges and benefits of the Glastir Woodland Creation and Woodland Management schemes, and identify barriers to help explain the low rate of uptake, as well as explore possible opportunities to encourage greater uptake of the schemes.

3.5.2 Results

The results of this study indicate little evidence of a conflict between land-use for agriculture and forestry. Contrary to previous published reports, famers across Wales appear to be open to woodland creation and appreciate the numerous on and off-site benefits associated with increased tree numbers. However, significant barriers exist in the form of the Glastir scheme process.

The process is perceived to undermine the scheme objectives and acts as a disincentive for potential scheme members from both the farming community and the Local Authorities. We conclude that a number of key elements are explored and adapted to encourage greater scheme uptake:

- The application process should be simplified. The complex nature of the scheme, e.g. operation prescriptions for size and width of woodland, is a barrier.

- The scheme needs to be more flexible to account for external influences. The scheme is perceived to be inflexible, e.g. not allowing postponement of activities due to weather conditions. Its inflexible rules represent a barrier to uptake.
- The auditing process is complex and includes penalties, e.g. withdrawal of Glastir payments, and therefore penalties need to be clearer and the auditing process needs to be less threatening, to encourage greater uptake.
- Payment rates are obscure, e.g. there is confusion about what is covered and rates for contractual labour are not included. These need to be made clearer to encourage potential members to adopt the scheme.

The full report on *Understanding barriers to uptake of Woodland creation schemes* can be found as Appendix 3.1.

3.5.3 Recommendations

- Woodland creation is an activity promoted by Glastir to increase carbon sequestration and thus reduce overall GHG emissions from the land sector. However, uptake of the scheme has been low and a GMEP survey was designed to identify the barriers to uptake.
- The results indicated that the process is perceived to undermine the scheme objectives and acts as a disincentive for potential scheme members from both the farming community and the Local Authorities.
- Recommendations to improve uptake include:
    - To achieve greater scheme uptake the application process should be simplified.
    - The scheme needs to be more flexible to account for external influences.
    - The auditing process needs to be less threatening, and penalties need to be clearly communicated to encourage greater uptake.
    - Payment rates need to be clarified to encourage potential members to adopt the scheme.

3.6 Visual Landscape Quality

For a relatively small nation, Wales contains a remarkably diverse range of landscapes; from the coasts to the moors, the farmed to the industrialised (Figure 3.6.1). It is a mountainous country with significant areas of land above 300m and a diverse range of important habitats including saltmarshes, woodlands, bogs and montane. The unique physical characteristics of the landscape which derive from its diverse topography, geology, soils and climate have all helped to create a valued cultural and historic landscape which encompasses farming, rural buildings, towns as well as unique historical sites and industrial archaeology. Though largely rural and dominated by pastoral farming, the country does have over 3.1 million residents (ONS, 2013), the majority of whom live within the urban conurbations of south Wales (Cardiff, Swansea) and along the north coast and the fringes of the Dee Estuary. These numbers are dwarfed by the 100 million day visits and an estimated 6 million overnight trips made to Wales by recreational visitors in 2013 (VisitBritain, 2015). These visitors are attracted to the country by high quality landscapes, particularly the three national parks of Snowdonia, the Brecon Beacons and the Pembrokeshire Coast.

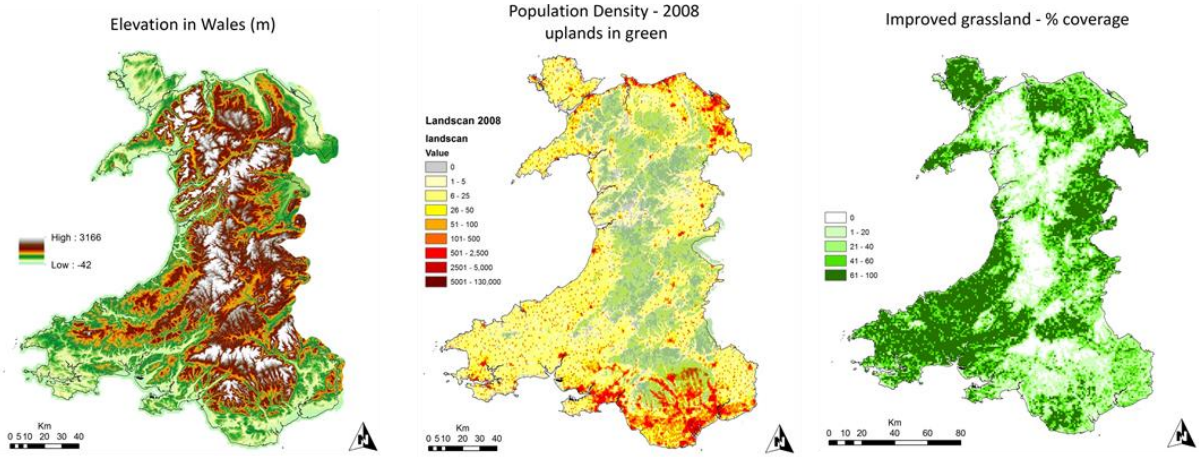


Figure 3.6.1 *Key physical and socio-economic characteristics of Wales which shape landscape character and quality: (L to R) elevation derived from 5m resolution terrain model; population density derived from the Landscan 2008 dataset; percentage coverage of improved grassland in each 1km derived from the CEH 2007 Land Cover Map.*

3.6.1 Landscape and Historic Environment as part of the Ecosystem Services Framework

Cultural ecosystem services include those non-material aspects of the natural environment which support societal needs for recreation and access to green space, alongside spiritual and religious enrichment (MEA, 2005). Indeed, the UK National Ecosystem Assessment of cultural ecosystem services outlines a myriad of contributions that natural landscapes make to our physical and mental well-being (Church *et al*., 2014).The need to both preserve our shared cultural heritage and have access to aesthetically pleasing natural environments is central to this concept and plays an important role in the shaping of GMEP. In Wales, there is a strong sense of "place-based identity" and the connections between the Welsh language, history, culture and physical environment have been enshrined in a number of policy documents, including the Welsh Government's position statement on the historic environment (Cadw, 2012) and the Wales Landscape Partnership agenda for the protected landscapes of Wales (WLP, 2009).

3.6.2 Current Status and Trends

Overall, when averaged across the whole of the country, the habitats which define the Welsh landscape did not change significantly between 1998 and 2007 (Countryside Survey, 2007). This might imply that the landscape has been static; however in the UK such stability is rare and detailed analysis of the Welsh squares within the survey revealed that there were some important changes in specific components of the landscape. These included an increase in the overall area of built land, which increased by 14,500ha (a rise of 12.5%) and an increase in the area of broad-leaved woodland across lowland Wales (rising by 12%). Woody linear features are important in landscape quality assessments and they make up over half of all boundaries in Wales. Within these boundaries there has been a reduction in the length of managed hedgerow as previously stock-proof hedges have deteriorated into lines of trees. The recently published State of Nature report 2013 and analysis of the species data for Wales in Countryside Survey indicates a decline in overall species diversity. These declines may have cultural significance when considering specific aspects of landscape quality, for example, in Wales 57% of flowering plant species are in decline and this may negatively impact on visitors' enjoyment of certain landscapes in spring and early summer (Burns et al. 2013).
There is no doubt that high quality landscapes and heritage features are a valued resource in Wales, attracting visitors to the country and generating income across many different sectors. There is clear recognition of the significant contribution of the historic environment to quality of life in Wales. The recent Historic Environment Strategy for Wales (Welsh Government, 2013) is focused on actions to

enable the protection of Wales's heritage while also encouraging public access, enjoyment and participation. The historic environment comprises a diverse set of assets ranging from formally designated sites to locally important landmarks and features. Across Wales there are 3 World Heritage Sites, 428 registered historic landscapes, parks and gardens, 519 conservation areas, 4,000 scheduled ancient monuments and 30,000 listed buildings.

There is evidence that such assets contribute to a range of benefits spanning job creation, tourism, place-making, identity, education and community involvement. Research to assess the value of the historic environment in Wales (ECOTEC, 2010) estimated that the sector supports over 30,000 jobs and contributes around £840 million to national gross value added (GVA). Some of the most popular visitor attractions in Wales are heritage sites, including Conwy Castle which attracted over 160,000 visitors in 2012. The historic environment is widely used in the promotion of Wales as a destination and is one of most popular reasons cited by visitors in Visit Wales research of visitor motivations. However, the strategy identifies a need for action to increase accessibility, understanding and engage under-represented groups. The cost of maintaining and restoring assets is also a significant challenge. The 'Programme for Government', set out in 2011 for the current term, includes an aspiration to enrich the lives of individuals and communities through culture and heritage with a longer-term goal to increase the percentage of historic environment assets in a stable or improved condition. The 2013 update reports that public engagement with heritage is growing and there has been some success in strengthening the place of the Welsh language in everyday life and the percentage of historic environment assets in a stable or improved condition is estimated at just over 78%[1].

Public Rights of Way (PROW) are common throughout the managed landscapes of Wales, often linking farms and settlements together as well as providing routes across mountains and across open land. They are an important resource, particularly for tourists to Wales many of whom come specifically to walk.

3.6.3 Aims of Glastir with respect to landscape & historic environment

Glastir explicitly recognises the importance of the Welsh landscape; one of the six stated aims of the programme is to manage and protect the Welsh landscape and the historic environment therein, whilst retaining and promoting public access. Four specific landscape targets are outlined in the programme including: ditch landscapes; historic features and landscapes; pond landscapes and protected landscapes. An additional five targets have significant landscape quality components and include those relating to orchards; parkland and wood pastures; parks and gardens; permissive access and woodland. Within each of these targets are specific management options which have direct impacts on the potential quality of the landscape view. Notable amongst these are options for the management of woodland, hedgerows, native trees, water features such as ponds and reedbeds as well as stock management around water features and on archaeological sites. These landscape management options are detailed in Appendix 6.5 of the GMEP first year report (Emmett et al. 2014:175).

[1] This figure is based on an assessment of listed buildings and scheduled ancient monuments. The corresponding figure in 2008 was 75% which suggests that progress has been made; however, it is noted that prior to 2012 the percentage of listed buildings deemed to be not at risk was used to represent those in a stable or improved condition but in 2012 a more accurate assessment of those in a stable or improved condition has been used. Cadw is now looking at ways to extent this evaluation to a wider group of historic environment assets.

Within the ecosystem services approach taken by GMEP, the work of the landscape and historic work package contributes specifically to the measurement of the cultural ecosystem services provided by the Welsh landscape. The aims of the landscape component of GMEP are fourfold:

- To assess visual landscape quality using measures which are objective, transparent and repeatable.
- To quantify the accessibility of the GMEP 1km survey squares both in terms of physical accessibility through the Public Rights of Way network (PROW) and a derived measure of visual accessibility which takes account of the view as experienced by the public within the landscape.
- To quantify the condition of the historic assets present.
- To assess the impact of change on the visual quality of these landscapes through landscape changes implemented through the Glastir programme.

3.6.4 Benefits of past schemes

In Wales, Glastir has replaced a number of agri-environment schemes including Tir Gofal, the entry-level scheme of Tir Cynnal and the Tir Mynydd scheme which provided specific support payments to hill-farmers in the Less Favoured Areas.

Under Tir Gofal many of the land management options were designed to protect and enhance components of the natural and cultural heritage of Wales whilst increasing permissive access. In addition, there were capital grants to support specific activities. A review found that 93% of Tir Gofal applicants in 2003 received a capital grant from a total budget of £7.15 million. Of these payments, a significant proportion was spent on activities which have a direct impact on the quality of the landscape and the maintenance of its historic context including: dry stone walling (15.3%), repair of the unique Welsh slate fencing (0.2%), hedgerow management (9.2%) and traditional farm building repair (7.4%). With respect to the creation of new ponds (1.3%) and the planting of new trees (0.5%) overall capital spend was much lower. A further 5.6% of the capital grants budget was spent on improving access through the creation of new permissive paths and improvements to existing access infrastructure (Agra, 2005: Table 3.8).

The mid-term evaluation of the Wales Rural Development Plan for the period 2007-13 (ADAS, 2010) found that in general terms, the area under agri-environment options was likely to at least maintain landscapes and features; and, in particular, Tir Gofal has resulted in a number of specific actions which will have contributed to maintaining and improving landscapes and features. It was also noted that the schemes have also played a role in decisions to remain in farming, usually as one of a number of factors, which will contributed to maintaining the structure of farming in Wales and, in turn, may have helped to maintain existing farm sizes and boundary features. A survey of participants in Tir Gofal, undertaken by the evaluators, asked whether beneficiaries had maintained or improved a range of landscape features since joining the scheme. The most frequently cited response was hedgerows (85%), followed by management of individual trees or orchards (50%) and public rights of way (44%). In terms of historic features, it was reported that work had been done to maintain or improve traditional buildings (37%), other historic features (including mines, ponds, cairns, ruined buildings and features associated with farming or mining) (28%) and scheduled ancient monuments (14%).

A more recent review of the impact of agri-environment schemes undertaken for the UK Government found that the entry level schemes that had operated in England and Wales since 2000 had positive impacts on maintaining landscape character and quality. There was significant uptake of landscape / historic options including the management of archaeological features under grassland; buffer strips in open landscapes; the maintenance of a pastoral character through the

support of low input grazing and mixed stocking, as well as through hedgerow management (FERA, 2013). These landscape impacts were most highly rated by those land managers in the Less Favoured Areas which in the Welsh context is significant as over 80% of the agricultural land in the country falls into an LFA, with 56% of it in severely disadvantaged areas.
Although there have been significant benefits accrued with respect to landscape quality under pre-existing agri-environment schemes, a note of caution must be sounded with respect to the historic and archaeological components of landscapes. A review undertaken by ADAS of the conservation of the historic environment in the English uplands highlighted that there was still a lack of information about this important resource and that this has been exacerbated by a focus on individual sites and features in existing agri-environment schemes rather than considering the historic landscape as a whole (ADAS, 2011).

3.6.5 Methods

The approach taken by the GMEP landscape team has been a sequential one, whereby the methods developed in year 1 have been tested through consultation with the general public in year 2 (Figure 3.6.5.1). Overall, the public have validated the approach taken in the VQI with the positive and negative weightings given to the landscape options that are incorporated within the metric being confirmed as correct.

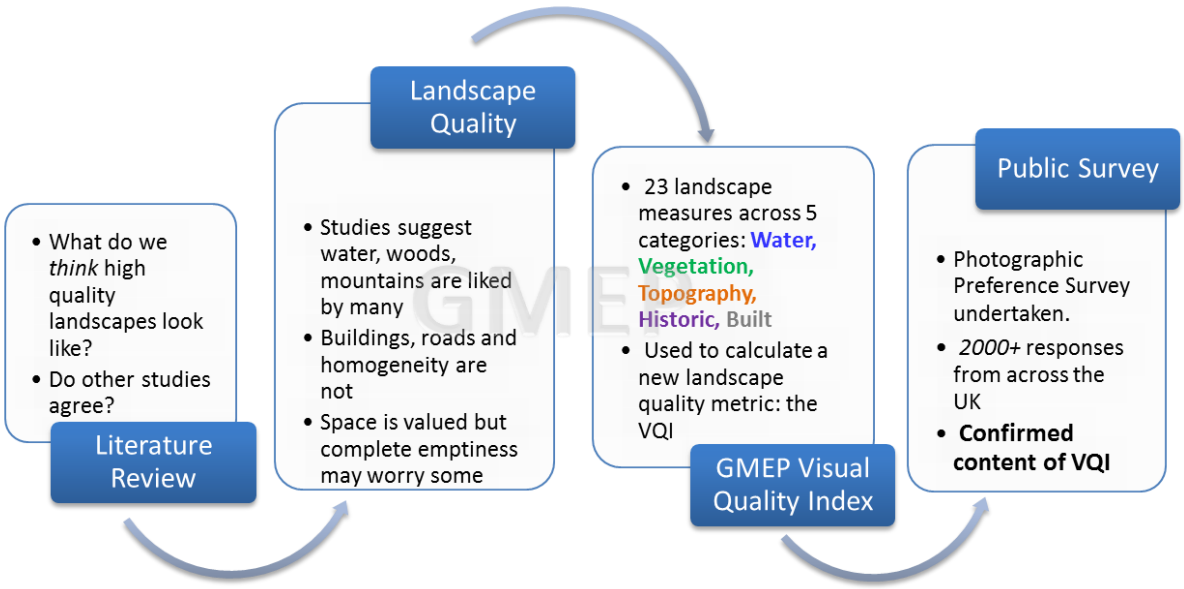


Figure 3.6.5.1 *A summary of the GMEP landscape approach.*

3.6.5.1 Visual Quality Index (VQI)

The VQI methodology is outlined in detail in the first year report (GMEP, 2013: 146-148). In brief, the GMEP Visual Quality Index (VQI) is a new measure of landscape quality with possible values ranging from 0 (worst) to 1 (best). It has five components: physical, blue-space, green-space, historic and built/unnatural.

Blue-space focuses on water and measures area (e.g. ponds), length (e.g. streams) and points (e.g. waterfalls) and contributes positively to the VQI. Green-space focuses on vegetation and measures area (e.g. woodlands), length (e.g. hedgerow length) and points (e.g. number of single large trees) and contributes positively to the VQI. Physical components of the VQI include a terrain roughness index (TRI) which has been adapted from an established geomorphological model originally published by Riley et al., in 1999. It uses a detailed 3D model of the land surface which splits the

entire land area of Wales into 5 metre cells, each having one value representing the elevation of that cell above sea-level. By calculating the difference between each cell and the average value of the nearest 8 cell neighbours an index is derived called the Terrain Ruggedness Index (TRI). This value gives an indication of the relative change in height and is more useful than a simple elevation or slope dataset as it considers the context of each cell. Combined with geological information extracted from the Welsh LANDMAP database which defines those areas of high geological landscape value the physical component contributes positively to the overall VQI. The presence of historic / cultural features such as mottes, stone crosses, standing stones, listed buildings, scheduled ancient monuments are all included within the VQI as positive components of landscape quality. Finally the VQI calculates the length and area of roads, buildings, utilities and heavily managed or altered habitats such as monoculture arable and coniferous plantations and rates these negatively within the index.

The totals for each of these five component groups were collated, scaled between 0 and 1, and then the five groups were weighted equally to derive the final VQI.

3.6.5.2 Viewshed Analysis

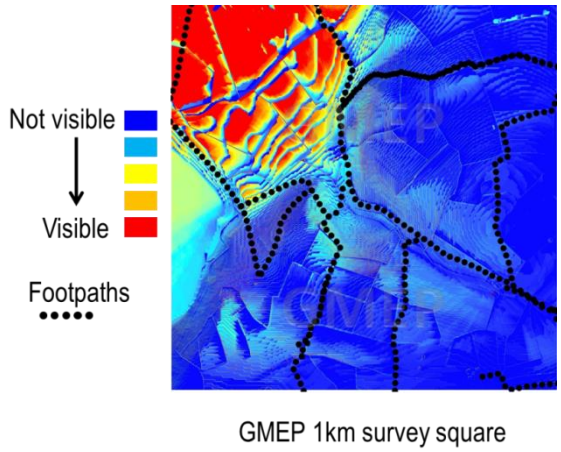


Figure 3.6.5.2.1 *An example pedestrian viewshed calculated for a 1km GMEP survey square. The footpaths from which the view is calculated are shown in black. For each 5x5m cell on the output, a value is derived showing the number of times that cell is seen from the observer points within the square. In this example the land rises steeply towards the north-west of the site and this part of the square is very visible to pedestrians within it.*

For a high quality landscape to be enjoyed, it must be physically accessible but also visible. Aside from designated open-access areas, the public can only physically move through a landscape using either the Public Rights of Way network (PROW) or the existing public highways. What can be seen depends strongly on topography but also vertical structures in a landscape - buildings, trees and high hedges will all obstruct views. By calculating the available view from a human perspective, a measure of the visual accessibility of a known location can be derived called a 'viewshed'. Calculating the viewshed of a landscape is computationally demanding and requires three key inputs: a 3D representation of the land surface; the location and height of all physical barriers such as tall buildings, hedges, woodlands and finally, observer locations from which to calculate the view (Figure 3.6.5.2.1). For each of our study sites four different categories of user were considered: pedestrians, cyclists, small vehicles such as cars and finally rail passengers. A 5m scale digital terrain model provided the base onto which physical barriers were added. This information came from the GMEP field survey which captured information describing the vegetation type, the height of linear features such as hedges. Standard building heights were assigned to structures where these were

not directly measured. Known observer locations were taken 20m apart along all the PROW in the square and these were complemented by random sampling within open access areas and on public beaches.

High quality landscapes have an important existence value; although an individual may never visit Snowdonia or the Welsh coast; they may feel strongly that the beauty of the Welsh landscape should be protected so that those members of the public that wish to explore and enjoy it can continue to do so. For visitors to derive a benefit from looking upon, or being within a high quality natural environment it must be both physically and visually accessible. The maintenance of views is therefore, important and studies from across the world show that even fleeting contact with green space improves human health and well-being. Knowing where access is limited may identify areas of high quality landscape that are currently hidden from many people and Glastir has the funding mechanisms in place to promote access into some of these lesser-known rural landscapes.

3.6.5.3 GMEP Photographic Preference Survey (PPS)

The GMEP photographic preference survey (PPS) was delivered online and had two main aims. Firstly, to validate the Visual Quality Index (VQI) by ascertaining whether the ranking assigned to landscapes using the VQI match the ranking of landscapes assigned by the public. In other words, are landscapes with higher VQI scores regarded by people as more 'attractive' than those with lower VQI? What particular landscape features are liked and disliked? Secondly, the questionnaire sought to investigate whether different demographic groups value the landscape in similar ways. Specifically, survey results were interrogated to determine whether the following groups rank landscape 'attractiveness' in the same or different way (and if different, how different their views were?):

i) Gender (male vs female)
ii) Age groups (youth vs middle-aged vs elderly)
iii) 'Perception of nationality' (Welsh vs British vs English)
iv) Welsh speaking vs English speaking
v) Urban vs rural dwellers:
vi) Location of childhood home
vii) Location of current home

3.6.5.4 PPS Survey Design and Distribution

An online questionnaire was prepared using Qualtrics® survey software and consisted of three sections. The first two sections aimed to collect relevant background information of the respondents, including their demographic data and their country-side visiting habits. The third (and main) part of the questionnaire focused on respondents' preferences towards the different types of landscape photographs (selected from the Year 1 field survey photographic archive) using three different forms of questions: a landscape rating; a hotspot choice and a feature response. In the first respondents were asked to rate how attractive they found each of the five presented landscape photographs. The rating was measured using an 11-point numerical scale ranging from 0 for 'Not at all Attractive' to 10 being 'Very Attractive'. Secondly, using the same five landscape images, respondents were then asked to select (by clicking their mouse cursor) one spot in the area they liked the most. This exercise developed a 'heat map' showing areas of preference. Lastly, various landscape features in six different photographs were marked by a surrounding rectangular frame, and respondents were asked to click once if they liked the feature (which turned the frame green), and twice to indicate dislike (turning the frame red), while clicking three times reset the frames to 'neutral' (Figure 3.6.5.4.1) .

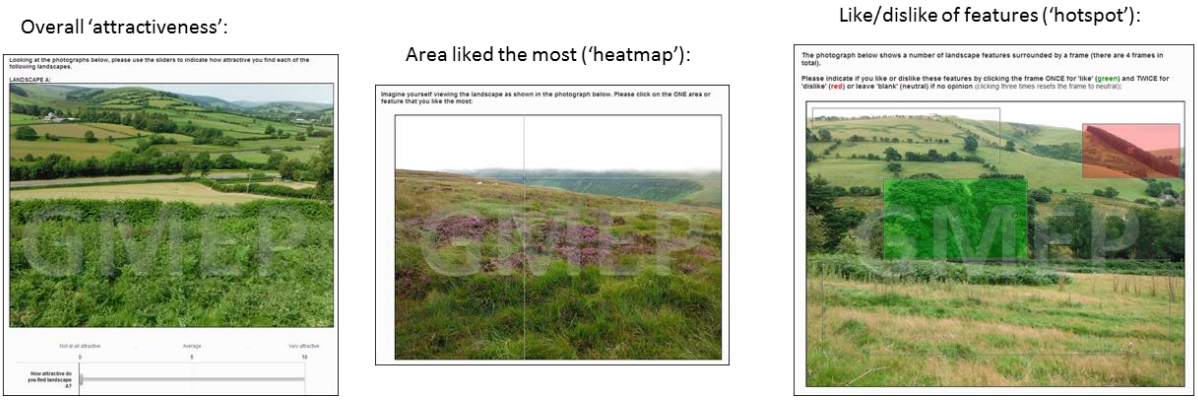


Figure 3.6.5.4.1 *The three types of question asked during the photographic preference survey. (L to R) Sliding scale of attractiveness from 0 to 10; choosing one location on the landscape that is liked the most – data are collected to produce a heatmap of all responses; feature response where individual components of the photograph are highlighted in boxes which the user can either choose to like (green), dislike(red) or leave neutral.*

The survey was piloted and also translated into Welsh. To aid the dissemination of the questionnaire, a dedicated webpage (http://www.glastir-mep-surveys.org.uk/) was created to host the surveys. A 'snowball' sampling technique was employed utilising two sources for respondents:
a. **Public group database.** A database of groups and organisations was created to capture the opinions of various demographic groups. This included residents associations, community groups, elderly (OAP) groups, youth groups, women's institutes and Welsh societies.
b. **GMEP network.** The survey webpage link was circulated to 78 individuals in the GMEP network, which included all GMEP partners (67) as well as a number of the Welsh Government employees (approx. 9) who in particular work and have links with community groups in Wales.
The survey was initiated in September 2014 and closed at the end of June 2015, responses now number over 2600, with respondents across the UK. However the results presented in this report are based on the responses collected between September 2014 and January 2015, the full dataset will be re-analysed in year 3 but it is not envisaged that the larger sample will change the key findings presented here

3.6.5.5 Historic Environment Features

The GMEP survey team undertook a condition assessment of selected historic features identified within each of the survey squares following training from Cadw staff. Once the feature had been identified in the field, photographs were taken. The condition of the feature was assessed as either: excellent; sound with long standing defects; sound with minor defects; signs of potential deterioration; major signs of deterioration; or damaged. Current challenges to the site were also then identified including problems being caused by stock (such as stockwear poaching, erosion and burrowing animals), agricultural operations (such as ploughing, dumping and pasture improvement), vegetation (such as bracken or gorse) as well as a range of other more general issues (such as vandalism, quarrying, stone removal). Surveyed features were primarily undesignated sites which have been documented in the HEF dataset, but the sample also included a number of designated sites, including 5 SAMs.

3.6.6 Results

3.6.6.1 Visual Quality Index: Year 1 and 2 Summary Statistics

The distribution of the VQI values ranges from a low value of 0.30 to a maximum of 0.68 for the 150 1st and 2nd year sites (Figure 3.6.6.1.1) and show a normal distribution (Figure 3.6.6.1.2). The VQI is made up of five components which are all scaled between 0 and 1 before combining them to derive

the final score. This means that these five components are weighted equally in the overall VQI even though they have varying numbers of parameters feeding in to their calculation (see GMEP 1st year report for further details on the VQI derivation). It can be seen from the individual statistics (Table 3.6.6.1.1) and from the boxplots representing these distributions that the water components of the square (blue space) have a much smaller range (so typically there is usually some water in the GMEP 1km survey squares somewhere) but there can be extremes where the site can be dominated by water. This is most notable with the coastal sites. Again, the historic features are often completely absent from the sites, accounting for the low tail on the bar chart describing the range (Figure 3.6.6.1.3).

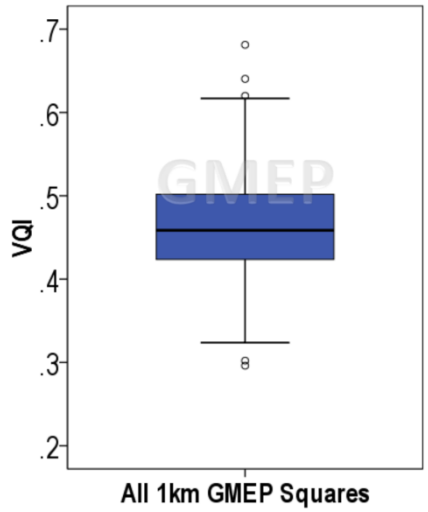


Figure 3.6.6.1.1 *The statistical distribution of the VQI for all 150 1st and 2nd year GMEP 1km survey sites. See* **Table 3.6.6.1.1** *for values associated with these data.*

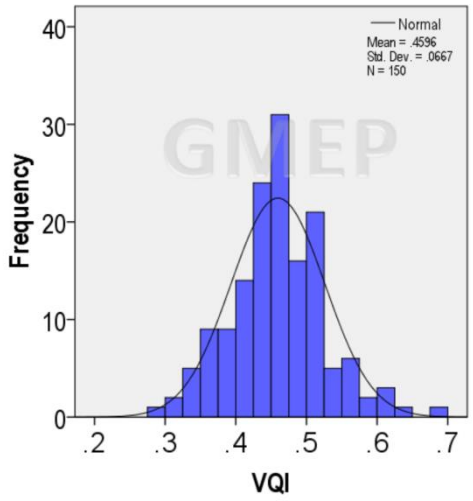


Figure 3.6.6.1.2 *The VQI data exhibit a normal distribution across the 150 1st and 2nd year GMEP 1km survey squares.*

Component	Min	Max	Mean	Std. Deviation	1st Quartile	Median	3rd Quartile
Physical Landscape	0.14	0.86	0.57	0.17	0.43	0.57	0.71
Blue Space	0	0.93	0.31	0.14	0.27	0.30	0.33
Green Space	0.16	0.94	0.58	0.19	0.44	0.63	0.72
Human Influence	0.20	1.00	0.67	0.17	0.57	0.70	0.77
Historic / Cultural	0	0.80	0.18	0.18	0	0.20	0.24
VQI	**0.30**	**0.68**	**0.46**	**0.07**	**0.42**	**0.46**	**0.50**

Table 3.6.6.1.1 *The statistical description of the five components of the Visual Quality Index*

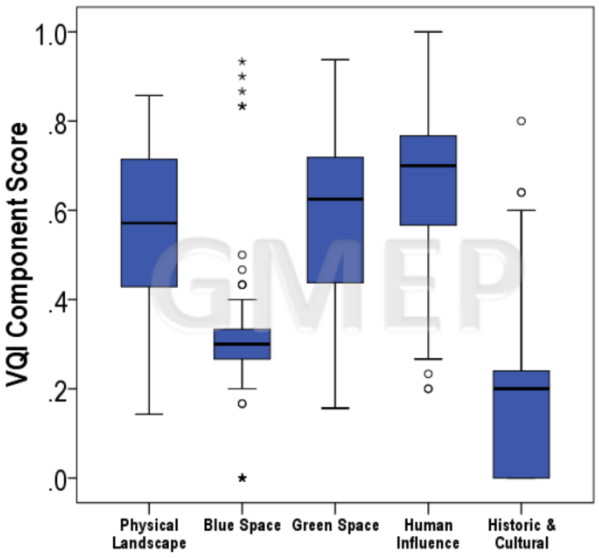


Figure 3.6.6.1.3 *The five components of the VQI (all weighted equally), showing the variation in the range of values present.*

3.6.6.2 What contribution does terrain make to the perceived quality of the Welsh landscape?

Wales is a mountainous country and the varied terrain defines its landscape character. Elevation (or height) is not the sole factor of importance; rather relative differences in height provide interest. Landscape preference surveys from across Europe indicate that rugged, mountainous landscapes are valued by people. Mountains give a sense of scale to a landscape, affording the viewer the opportunity to see across long distances when at height. They can also enclose landscapes and define valleys. Mountainous landscapes often have geological interest and provide opportunities for the geological characteristics of a location to be easily spotted.

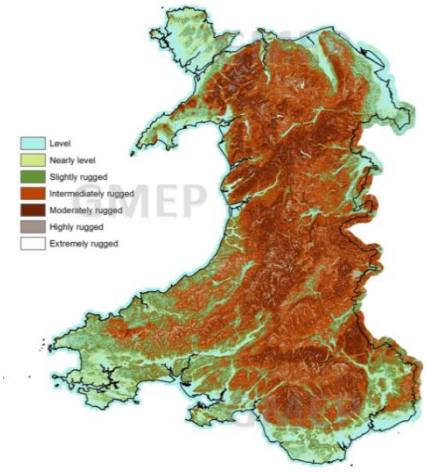


Figure 3.6.6.2.1*The Terrain Ruggedness Index used in the GMEP VQI, adapted from Riley et al.,1999.*

At a European scale, the mountain peaks of Wales are not high in comparison with the Swiss Alps or the Sierra Nevada in Spain but the majority of the country is rugged which contributes to high landscape quality ratings.

The terrain roughness index has been adapted from an established geomorphological model originally published by Riley et al., in 1999. It uses a detailed 3D model of the land surface which splits the entire land area of Wales into 5 metre cells, each having one value representing the elevation of that cell above sea-level. By calculating the difference between each cell and the average value of the nearest 8 cell neighbours an index is derived called the Terrain Ruggedness Index (TRI). This value gives an indication of the relative change in height and is more useful than a simple elevation or slope dataset as it considers the context of each cell (Figure 3.6.6.2.1). The model was applied to the whole of Wales and a ruggedness value was calculated which classified the cells into one of seven classes: level(27.92%), nearly level (4.38%), slightly rugged (15.82%), intermediately rugged (35.81%), moderately rugged (15.80%), highly rugged (0.25%) or extremely rugged (<0.01%).

These values indicate that only one-third of the country (32.3%) is classed as relatively flat (Level and Nearly Level classes combined) and it can be seen that these areas are largely confined to Anglesey, Pembrokeshire and the main river valleys. The complexity of the Welsh topography is clearly shown with high values correctly coinciding with the upland areas of Snowdonia, the Brecon Beacons, the Rhinogs and Berwyn Mountains amongst others.

3.6.6.3 Does the VQI differ between upland and lowland areas?

There is no significant relationship between elevation and the overall quality rating for the first year study sites. When the overall Visual Quality Index for sites with a median elevation of below 200m is compared to those over 200m it can be seen that the range of VQI values for the lowland sites is large and includes both the highest VQI rating (so the best quality landscape) and the lowest VQI values. The upland landscapes have a smaller range of VQI values and a higher overall median value which indicates that they tend not to include the lowest quality landscapes (Figure 3.6.6.3.1). Although rugged terrain and a varied topography contribute positively to the overall VQI, they are only one part of the measure. As elevation increases, the overall tree cover and plant species diversity will tend to decline, so higher elevation alone will not lead to high VQI scores. It is only where a range of positive values coincide that very high landscape quality scores will prevail.

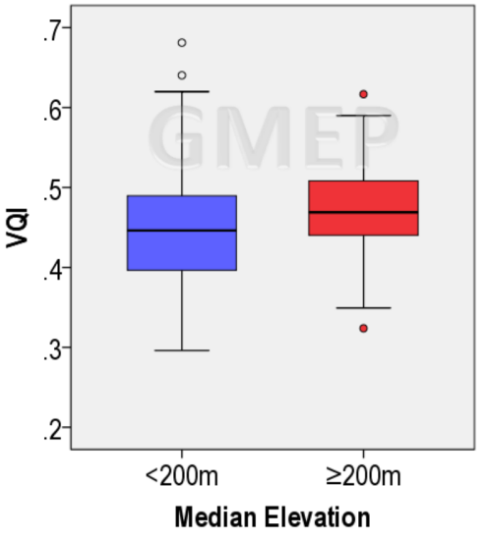


Figure 3.6.3.3.1 *The VQI for areas below 200m and those above.*

3.6.6.4 Does the VQI differ inside and outside protected areas?

There are many different categories of landscape designation in Wales, reflecting local, national and international priorities and these protected areas cover nearly 30% of the total land surface of the country (JNCC, 2014). Many of these sites are designated for nature a conservation purpose which often does contribute to overall visual quality, though the link is not always direct. Some SSSI's for example, are specifically designated for a single species or rare habitat which would not be discernible when viewed by the public reacting to the wider landscape scale.

The location of all known protected areas has been mapped and is available as a spatial dataset. The location of the 150 1st and 2nd year GMEP 1km survey squares was overlaid on this protected area map and used to classify each square either into or outside of a protected area. These two groups of squares were then compared to assess whether there were significant differences between the landscape components of the squares, using the GMEP Visual Quality Index (VQI). The VQI is a new measure of landscape quality with values from 0 (worst) to 1 (best). It has five components: physical, blue-space (water), green-space (vegetation), historic and unnatural (built, roads, utilities).

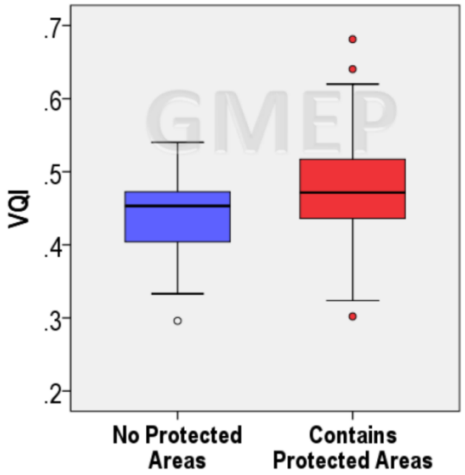


Figure 3.6.6.4.1 *The VQI of the 1st and 2nd year GMEP 1km survey squares (n= 150) compared inside and outside of protected areas.*

Results indicate that there is no statistical difference between the mean quality ratings assigned to the GMEP 1km survey squares which fall within / without of a protected area. However, Figure 3.6.6.4.1 shows that there are clear differences in the range of values, with all the highest values falling into protected areas. The first two years of data revealed that 84 / 150 of the GMEP 1km survey squares were within or partly within a protected area (defined as National Parks, Area of Outstanding Natural Beauty, Sites of Special Scientific Interest, and National Nature Reserves). When these data are split into the components of the VQI (Figure3.6.6.4.2) two things are immediately apparent. Firstly, it is clear that the physical landscape components inside protected areas have significantly higher values than outside. This reflects the dominance of mountain regions in the protected areas of Wales (most notably Snowdonia National Park and the Brecon Beacons). Secondly, the greenspace components are significantly lower inside the protected areas. The greenspace component is heavily dependent on vegetation including parameters describing the area of woodland, hedgerows and a habitat diversity scoring. In many of the valued upland landscapes of Wales, these measures will be lower because the bogs, upland habitats and montane regions do not have high scores.

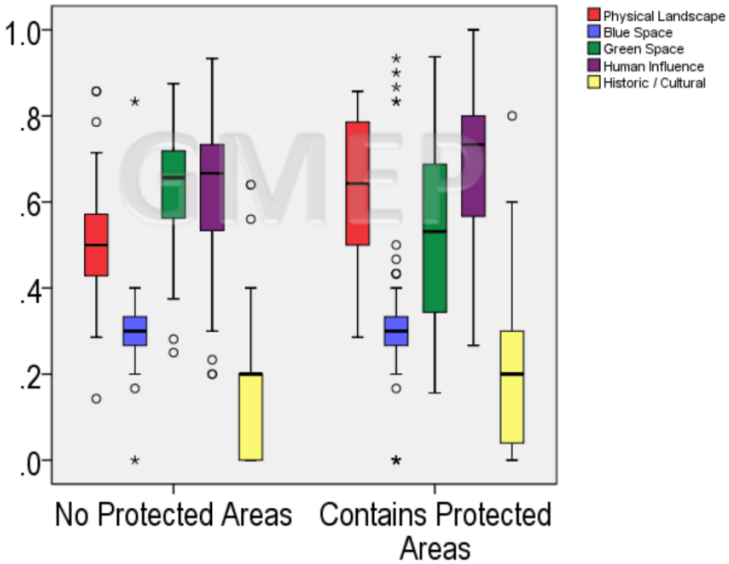


Figure 3.6.6.4.2 *The VQI of the 1st and 2nd year GMEP 1km survey squares (n= 150) compared inside and outside of protected areas, broken down by VQI category.*

3.6.6.5 Do landscapes with a high VQI have greater plant diversity?

The link between species rich locations and peoples' preferences for a landscape is not well understood. Ecological surveys of birds, plants or insects are often designed to work out what components of a habitat (such as presence of a particular nectar species or specific type of land management) are present where numbers are high. Rarely, are these detailed field surveys set within a survey framework as comprehensive at a landscape scale as GMEP. Here we are measuring many ecological indicators of habitat quality at the same locations as landscape quality is being assessed. Within GMEP we have the opportunity to evaluate these potential links with a large dataset and one where the landscape quality indicators are derived from the same field survey data used for the species and augmented by a wide range of landscape measurements.

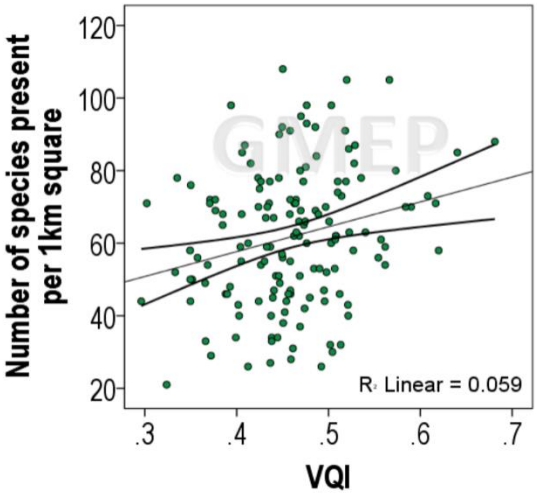


Figure 3.6.6.5.1 *The overall VQI (landscape quality index) compared against the total number of species present in the 150 1st and 2nd year 1km GMEP survey squares.*

The relationship shown in Figure 3.6.6.5.1 is not significant .The lack of a strong overall trend here is perhaps unsurprising as many species-rich habitats tend to occur in the lowlands and may be associated with an increased variety of habitat rather than necessarily higher quality habitat. The valued scenic upland landscapes are often dominated by larger blocks of single habitat types, which may be in themselves relatively poor in overall number of species (such as the montane habitats of Snowdonia) when compared against lowland heaths or woodlands but their component species may be rare and of international significance.

3.6.6.6 Do landscapes with a high VQI have greater bird diversity?

Data from bird surveys conducted in 2013 and 2014 on 150 GMEP 1km survey squares was collected by BTO surveyors during the 3 month breeding season, April – June. These data have been collated and compared against the overall VQI (Figure 3.6.6.6.1). At this summary level, no relationship is shown between the landscape quality rating and the number of bird species present in a 1km survey square.

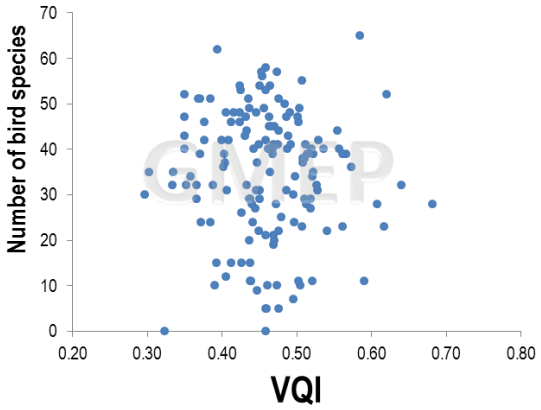


Figure 3.6.6.6.1 *The overall VQI (landscape quality index) compared against the total number of bird species present in the 150 1st and 2nd year 1km GMEP survey squares.*

However, for the individual components of the VQI a number of trends were revealed of interest. As the area of built and human-influenced landscape features increases, the number of bird species declined which would be expected. This negative relationship was also observed when the physical landscape components of the VQI are mapped against bird species diversity which implies that as the landscape become more rugged, the number of bird species declines. Finally, the green-space component of the VQI, which measures a range of parameters to do with woodland, hedgerow length, plant species and habitat diversity, shows the expected positive response to the number of bird species. These trends helpfully provide further validation for the general VQI approach (Figure 3.6.6.6.2).

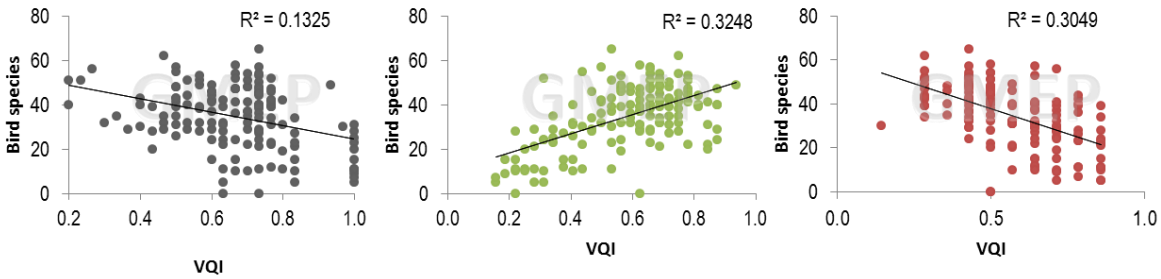


Figure 3.6.6.6.2 *Left = Built component of the overall VQI, Middle = Greenspace (vegetation) component of the overall VQI and Right = Physical component of the VQI compared against the total number of bird species present in the 150 1st and 2nd year 1km GMEP survey squares.*

3.6.6.7 Do landscapes with a high VQI have greater butterfly diversity?

n = 150	Min	Median	Mean	Max
Number of individual Butterflies averaged across 2 surveys	0	25	40.23	270
Butterfly species diversity (Shannon Diversity Index)	0	0.37	0.38	1.23

Table 3.6.6.7.1 *Butterfly data for the 1st and 2nd year survey squares*

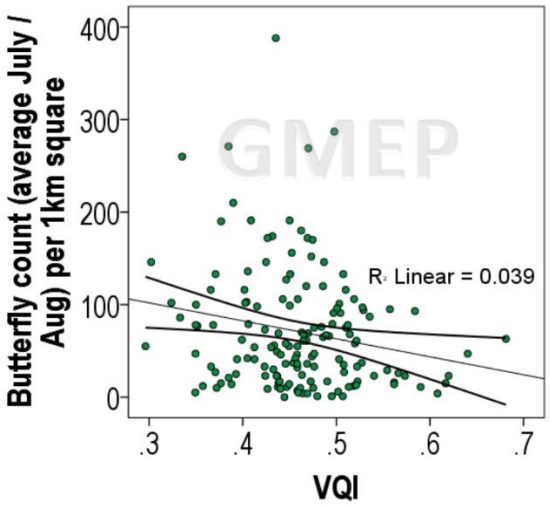


Figure 3.6.6.7.1 *The overall VQI (landscape quality index) compared against the total number of butterflies present in the 150 1st and 2nd year 1km GMEP survey squares.*

When the total number of butterflies observed during the 1st and 2nd year field survey visits is compared to the GMEP landscape VQI, a very weak negative relationship is indicated but this is not significant. The slope of the fitted line implies that the lowest rated landscapes actually have more butterflies but it is clear that there is a great deal of scatter (variation) around this indicating that the relationship is not explained by the measures captured in the landscape VQI (Figure 3.6.6.7.1, Table 3.6.6.7.1). This may be due to scale issues as the landscape VQI is working at a 1 – 3km scale, whereas insect diversity will probably be responding to intricate variations in habitat and plant species diversity that are masked when considered at the whole square scale.

3.6.6.8 Do landscapes with a high VQI have greater bee diversity?

Pollinators like bees are important to the health of the countryside; it is thought that nearly 80% of the flowering plants in temperate areas are reliant on insects for their reproduction. In addition, at least 35% of global food production is dependent on pollination – many of our key combinable crops such as oil seed rape require insect pollination. As recently as 2010, the UK Parliament estimated that this "service" that is provided for free by bees and other insects is worth at least £400 million per year to the UK economy. Bees in particular, seem to provoke a positive response in many people, as their pollinating work on our behalf, is very visible. They obviously require nectar-rich plants to feed upon, so flowers are critical to their survival. Flowers are also valued visual components of a landscape and colour rich meadows and flower-filled hedgerows and field ditches are often highlighted in preference surveys by the general public. Certain flowering events (such as the bluebells opening in spring or the heather flowering in the early autumn) are sensory delights to most visitors and highly valued.

Bees along with butterflies and hoverflies were surveyed twice during the GMEP field season, once in July and once in August. Surveyors walked a 2km route in each GMEP 1km survey square and recorded both presence as well as conducting timed observations in 150m areas. Pollinator surveys were only conducted between 10:00 and 16:00, or between 09:30 and 16:30 if >75% of the survey area was un-shaded and weather conditions were suitable for insect activity. Temperature had to be

between 11 and 17°C with at least 60% sunshine or above 17°C regardless of sunshine, and with a wind speed below 5 on the Beaufort scale (small trees in leaf sway).

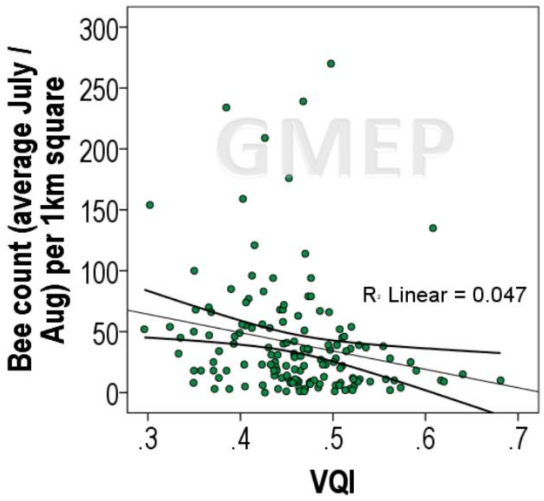


Figure 3.6.6.8.1 *The overall VQI (landscape quality index) compared against the total number of bees present in the 150 1st and 2nd year 1km GMEP survey square.*

When the total number of bees observed during the 1st and 2nd year field survey visits is compared to the GMEP landscape VQI, a very weak negative relationship is indicated but this is not significant. The slope of the fitted line implies that the lowest rated landscapes actually have more bees but it is clear that there is a great deal of scatter (variation) around this indicating that the relationship is not explained by the measures captured in the landscape VQI (Figure 3.6.6.8.1, Table 3.6.6.8.1). This may be due to scale issues as the landscape VQI is working at a 1 – 3km scale, whereas insect diversity will probably be responding to intricate variations in habitat and plant species diversity that are masked when considered at the whole square scale.

n = 150	Min	Median	Mean	Max
Number of individual Bees averaged across 2 surveys	0	25	40.23	270
Bee group diversity (Shannon Diversity Index)	0	0.37	0.38	1.23

Table 3.6.6.8.1 *Bee data for the 1st and 2nd year survey squares*

3.6.6.9 Do landscapes with a high VQI have greater functional connectivity?

Mixed landscapes offer opportunities for increased biodiversity, both in terms of habitat and species. Landscape preference surveys indicate that humans also value variety in their view and respond positively to small-scale landscapes with a mixture of woodlands, wetlands, fields and settlements. When ancient woodlands, wetlands and heathlands become isolated through encroachment of farming, settlements or infrastructure their ecological value diminishes. Species may no longer be able to move freely across a landscape and overall ecological resilience can suffer. A connected landscape functions better – so a well-managed set of hedgerows, grass margins or ditches will allow animals and plants to thrive. Such management also contributes positively to landscape appearance. The link between ecological connectivity and landscape quality can be explored within GMEP by combining the VQI with landscape metrics in order to evaluate whether bio-diverse landscapes are attractive to people.

Mapped habitat data for each GMEP 1km survey square was analysed using robust landscape metrics to assess fragmentation, complexity and connectivity. These mathematical descriptions of landscape include measurements of broadleaved woodland landscape connectivity, habitat diversity, habitat fragmentation, mean patch size (so how big do the bits of similar habitat tend to be?) and shape. Such functional landscape analysis is a well-accepted method of describing the

complexity and structure of the land cover of an area and has the advantage that it is objective, quantifiable and repeatable. These data were then compared against the calculated GMEP Visual Quality Index for each site to explore possible relationships between ecological value and landscape value (Figure 3.6.6.9.1). Results were non-significant and showed a wide range of values for the two key connectivity indices.

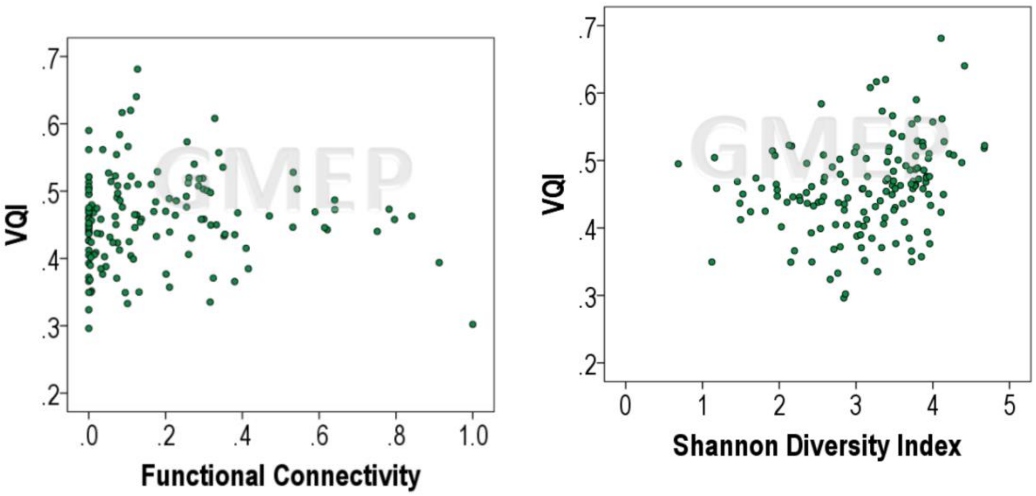


Figure 3.6.6.9.1 *Functional connectivity index for broadleaved woods and the Shannon's Diversity Index calculated for the habitats within the 150 1st and 2nd year GMEP survey squares compared against the overall landscape VQI. No statistically significant trends are revealed.*

3.6.6.10 Do landscapes inside Glastir have higher VQI values than those outside Glastir?

The Glastir scheme has nine target objectives with explicit landscape links including: ditch landscapes; historic features and landscapes; orchards; parkland and wood pastures; parks and gardens; permissive access; pond landscapes; protected landscapes and woodland. Within each of these targets are specific management options which have direct impacts on the potential quality of the landscape view and the subsequent VQI assigned to the site. Notable amongst these are options for the management of woodland, hedgerows, native trees, water features such as ponds and reedbeds as well as stock management around water features and on archaeological sites.
Areas of Glastir managed land were mapped for the GMEP survey squares. Those sites which contained areas of Glastir land were compared against those with none. Although there was some indication that those sites with higher VQI values were found within the Glastir managed scheme, the results were not significant at this scale (Figure 3.6.6.10.1)

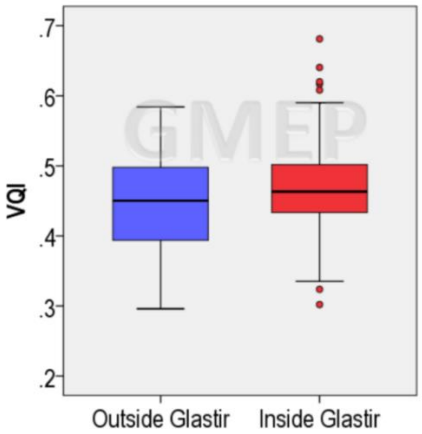


Figure 3.6.6.10.1 *Overall VQI values compared in sites with some Glastir managed land as compared against those within none.*

3.6.7 Viewshed Analysis Results

3.6.7.1 How visually accessible are the GMEP survey squares?

Visual accessibility is of course, strongly associated with physical accessibility which in turn is determined by the density of the PROW / Road network as well as the nature of that access. Pedestrians have the most access as they can use all types of PROW except for motorways. This is shown clearly within the results for the GMEP 1km survey squares where walkers and cyclists enjoy on average a view of 45% of the 1km square compared against 36% of people confined to a car (Table 3.6.7.1.1). In addition to the immediate viewshed of a 1km square, those visitors are also scanning further to take in wider landscape views and this is captured in the statistic which tells us how much of the surrounding 3 x 3km landscape of that square can also be seen from the 1km square. Again, pedestrians have most access to these wider views with on average 40% of the surrounding region being visible. The GMEP 1km survey squares also contribute to the landscape in which they are sited. The final statistic generated shows what proportion of the GMEP 1km survey squares can be seen from the surrounding 3 x 3km landscape. Here the figures are much higher, reaching 81% on average for the pedestrian group which reflects the overall density of roads and footpaths in Wales.

CATEGORIES OF USER	**% of 1km study sites which are visible from WITHIN the square**			**% of the surrounding 3 x 3 km area which is visible from WITHIN the 1km study square**			**% of 1km study sites which are visible from the surrounding 3 x 3 km area.**		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
Pedestrians	0	44.6	96.7	0	40.3	78.3	0	80.8	98.7
Cyclists / Horse riders	0	45.0	96.7	0	37.3	77.7	0	77.6	98.6
Small Vehicles	0	35.8	93.8	0	30.9	77.0	0	68.0	97.3
Railway	0	1.1	64.0	0	1.1	39.9	0	2.8	53.7

Table 3.6.7.1.1 *Calculated visibility for the four main categories of user at three different spatial scales generated from 1800 viewsheds for the 150 1st and 2nd year GMEP sites.*

3.6.7.2 How physically accessible are the GMEP survey squares?

People visit the countryside for a range of reasons from the purely recreational such as walking, climbing or bird-watching, to the less tangible such as finding some peace and quiet and mental relief from the pace of modern life. The health benefits derived from outdoor exercise and recreation can only be provided if the general public can physically access landscapes via the Public Rights of Way network (PROW). This defined network of roads, footpaths, bridle paths and open-access land provide the routes that people are legally allowed to use in order to explore the Welsh landscape. It is therefore, important to understand the distribution and the quality of this network. The length of each different type of transport route was calculated from the digital survey data collated for each site (Table 3.6.7.2.1). Additional information on the quality of this network has been collated through incidental surveys undertaken by the GMEP bird surveyors (from BTO) who made notes when they visited the survey sites in the spring of 2014. Surveys found that 57 of the 90, 2nd year sites had some PROW of which only 20 had fully open, signed and navigable paths. In a typical GMEP 1km square, only two-thirds of the paths on a 1km square were fully open, physically accessible and easy to find. Poor signage was common and many footpaths were infrequently used as a consequence which led to degradation and poor maintenance.

	Min	Mean	Max
Open Access Land (*including beaches*) (km^2)	0	0.107	1
Public Rights of Way (km)	0	1.495	5.724
Accessible Roads (km)	0.014	1.777	6.355
Public Rights of Way or Accessible Roads (km)	0	2.826	9.675

Table 3.6.7.2.1 *Calculated lengths of the Public Rights of Way network within the 150 1st and 2nd year GMEP 1km survey squares.*

PROW are common throughout the managed landscapes of Wales, often linking farms and settlements together as well as providing routes across mountains and across open land (Table 3.6.7.2.2). They are an important resource, particularly for tourists to Wales many of whom come specifically to walk. Of the first and second year sites, the digital data show that 133 of the 150 contained some PROW; the remaining 17 sites were all remote, upland sites. The distribution of paths varied significantly, but in places the network was dense with one site having nearly 6km of footpaths within the GMEP 1km survey square, though more typically this figure was between 1.5 – 3km. Roads are included here as a separate value, because in rural areas, these unclassified routes provide pedestrian access in addition to motor access and together with the footpaths can form a dense network of routes.

	Open Access Land (including beaches)		Public Rights of Way		Accessible Roads		Public Rights of Way or Accessible Roads	
	Count	%	Count	%	Count	%	Count	%
No	109	72.7	29	19.3	39	26.0	17	11.3
Yes	41	27.3	121	80.7	111	74.0	133	88.7

Table 3.6.7.2.2 *Counts of different classes of rights of way within the 150 1st and 2nd year GMEP sites.*

3.6.8 GMEP Photographic Preference Survey Results

By January 8th 2015, 1001 people participated in the survey, and of these, 976 completed the survey (97.5% completion rate). The majority of respondents, 874 (89.5%), chose to complete the survey in English, with 102 (10.5%) completing the Welsh version.

3.6.8.1 Demographics

3.6.8.1.1 Gender and Age

The sample is balanced between the genders, 48.5% of the respondents were female and 51.5% were male. While there was a relatively even distribution of respondents aged between 35 and 64, the proportion (18.2%) aged 65+ appears relatively large as it includes all 5 year cohorts up to 100 and although it looks anomalous it compares to an England and Wales average of 16% for the 65+ category (ONS 2011 Census data) and a figure of 18% for Wales (Baxter & Boyce, 2011). Only 0.3% of respondents were children (under 18) and 12.1% aged between 18 and 29 (Figure 3.6.8.1.1.1).

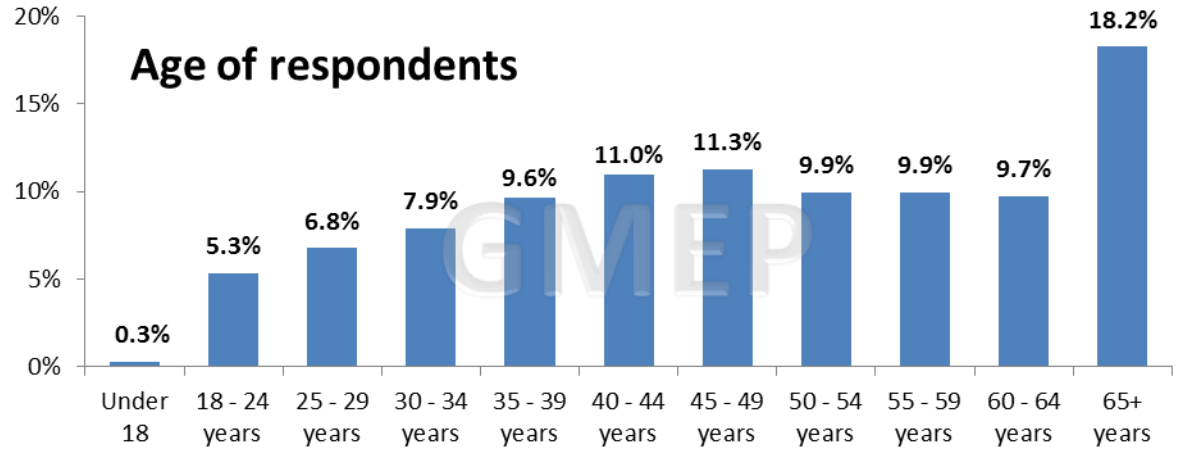


Figure 3.6.8.1.1.1 *Profile of the GMEP Photographic Preference Survey respondents, n = 976*

This distribution is perhaps unsurprising, considering the informal non-stratified approach that was taken to sampling in which it is difficult to control the distribution of the respondents. Accessing children's views is difficult online and will require targeted activity to address if deemed particularly important – for GMEP, this is not deemed to be a particular problem.

3.6.8.1.2 Location of respondents

Respondents are asked to provide the postcode of their home address at the start of the survey. The vast majority were willing to give their full postcode, with others opting to provide a higher level postcode. These data were converted and mapped to show the distribution of respondents both in the UK and more specifically in Wales.

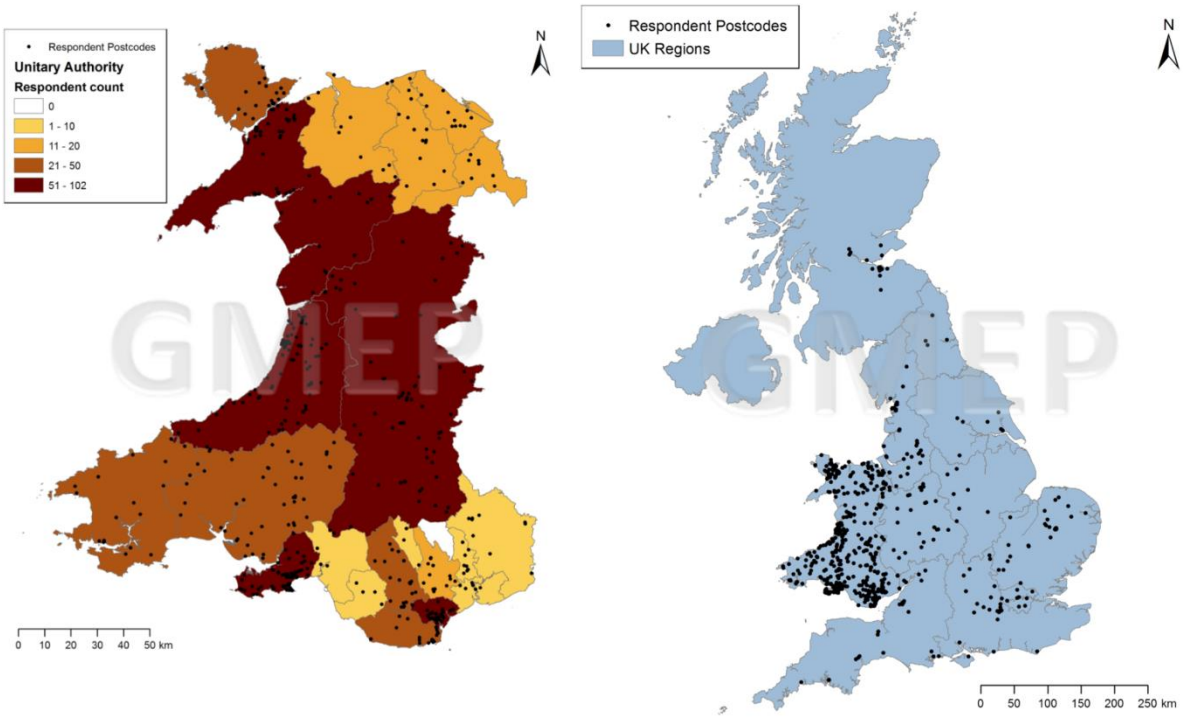


Figure 3.6.8.1.2.1 *Distribution of survey respondents from within Wales (left) and across the wider UK (right). Of the 976 completed surveys, 758 described themselves as Welsh (78%), 93 English (10%), 12 Scottish (1%), 113 as other which included those who chose British as their nationality and a small number of foreign visitors.*

3.6.8.1.3 Employment characteristics of respondents

The majority (72.3%) of respondents were employed either full time or part time, while around one fifth (21.2%) of respondents were retired. Wales does have the highest proportion of retired people within the four home nations of the UK, reflecting an aging population and a well-established trend for retirees to settle in the coastal communities. Around similar proportion were in education (3.4%) as in 'other' occupation. 'Other' occupations primarily included unemployed, volunteers, homemakers, carers and individuals who considered themselves as 'semi-retired' (Table 3.6.8.1.3.1)

Occupation Class	Frequency	Percent
In full-time education	33	3.4%
Employed (full time / part-time / self-employed)	706	72.3%
Retired	207	21.2%
Other (please specify, e.g. full-time carer)	30	3.1%
Total	**976**	**100.0%**

Table 3.6.8.1.3.1 *Employment of the GMEP PPS respondents (n = 976)*

3.6.8.1.4 Impact of childhood home / adult residence

The locations of where respondents grew up and currently live were proportionally similar. Around two thirds (58%) of respondents grew up in either a village or small town, with a slightly larger proportion (68.8%) currently living in a village or a small town (Figure 3.6.8.1.4.1).

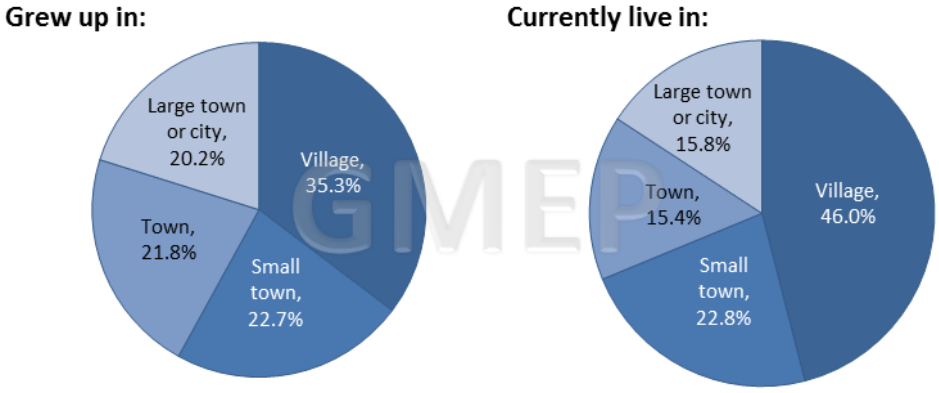


Figure 3.6.8.1.4.1 *Respondents childhood home versus current home, n = 976*

3.6.8.1.5 Nationality

The vast majority of respondents considered themselves either British (41.5%) or Welsh (40.1%). A smaller proportion considered themselves English (11.5%), while the 'other' nationalities (4.3%) primarily included individuals from other countries in Europe (1.1%, *n =11*), outside Europe (0.6%, n = 6) and those who considered themselves Welsh and British or other nationality (0.8%, n =8).

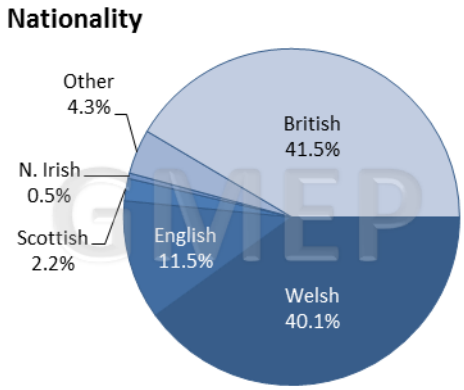


Figure 3.6.8.1.5.1 *Nationality of the GMEP Survey Respondents (n = 976).*

3.6.8.2 Countryside Visiting Habits

Figure 3.6.8.2.1 shows the frequency of respondents' visits to the countryside in an average month. Nearly half (44.9%) of the respondents make daily visits and a quarter (26.2%) visiting the countryside 2-3 times per week. A negligible proportion (0.2%) said they never visit the countryside.

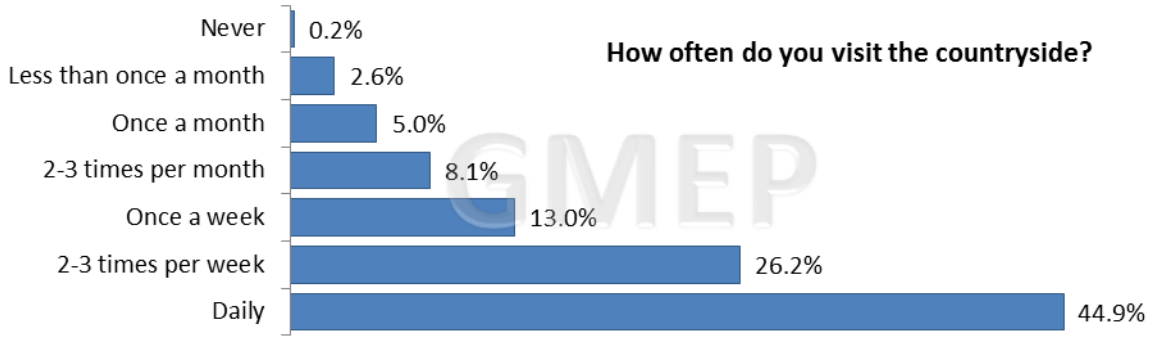


Figure 3.6.8.2.1 *Frequency (in a typical month) that the GMEP PPS respondents visited the countryside.*

The most common reasons for visiting the countryside (respondents could select as many of the options as they wanted) are summarised in Figure 3.6.8.2.2. The two main reasons were 'relaxation' and 'active recreation', which were selected by about two thirds (61%) of respondents. These were followed by 'health reasons', 'peace and quiet' and 'to explore and discover new places', which were selected by over half of the respondents.

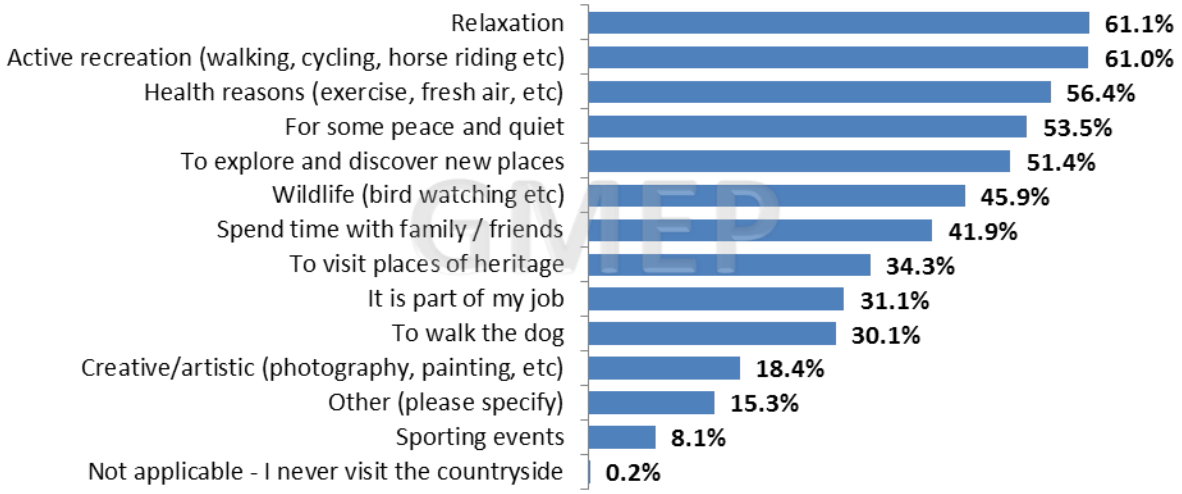


Figure 3.6.8.2.2 *Reasons given for visits to the countryside by the GMEP PPS respondents. Note that respondents were free to tick as many as applied so the % figures relate to how many of the total (n=967) chose that particular option.*

The majority of the 15.9% (149) respondents, who specified 'other' reasons for visiting the countryside, stated that they lived in the countryside (59%). Other reasons included astronomy and dark skies (11%), volunteering (7%), fishing/hunting (3%) and for visual enjoyment (3%).
When queried about how they accessed the countryside in order to engage in these activities, the majority of people used a private car (64%), followed by walking (28%) and more rarely by bicycle (4%). Only 3% of respondents stated that they typically used public transport which may well reflect the lack of service / coverage of such transport opportunities in many rural areas. The remainder either lived there and did not specify or used a mixed mode of transport, a small minority stated that they would run or use a horse.

3.6.8.3 Perceived value of the Welsh countryside

At the start of the GMEP PPS, before they had been shown any of the landscape photographs a baseline question was asked as to how important the Welsh countryside was to them. Bearing in mind that only 40% of the survey specifically identified themselves as Welsh it is clear that this landscape is valued and has an existence value for many. The vast majority of respondents (96.4%) considered the Welsh countryside to be either 'important' or 'very important' to them, with only a negligible proportion (0.3%) declaring it be 'unimportant' or 'not at all important'. Only 3.3% had neutral feelings.

3.6.8.4 Overall attractiveness of the Welsh countryside

In order to assess the general validity of the GMEP VQI, five sets of landscape photographs were included in the PPS (Figure 3.6.8.4.1). These sites represented the full range of VQI values (minimum, lower quartile, median, upper quartile, maximum). By asking the respondents to rate these landscapes from 1 (low – unattractive) to 10 (high – very attractive), we could check whether the VQI was capturing values that did in some way capture useful information about the aesthetic that could be perceived by the general public.

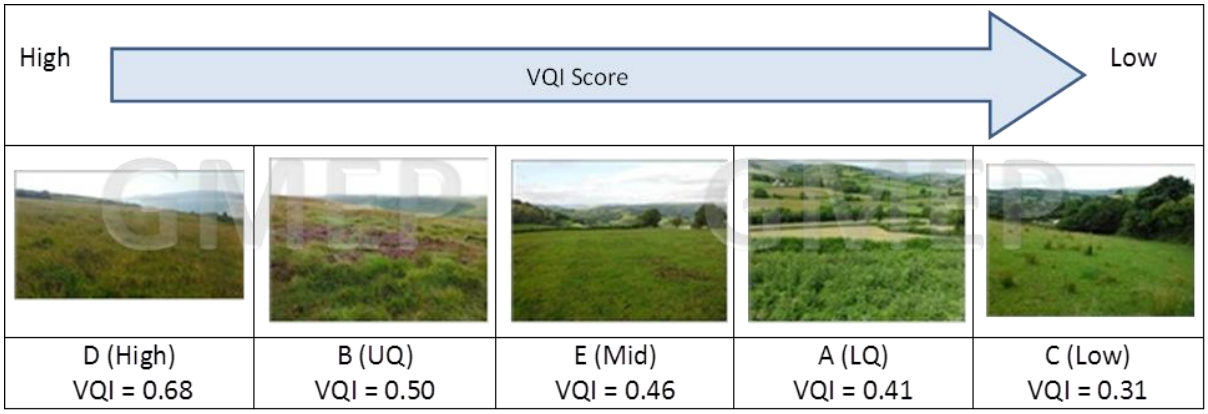


Figure 3.6.8.4.1 *The five landscape photographs representing the range of the VQI, used within the GMEP photographic preference survey.*

Overall, the order of landscape attractiveness indicated by the respondents matches the order indicated by the VQI except towards the higher end of the scale. Landscape B was considered most attractive when all respondents were grouped (M= 7.77, SD= 2.01), followed very closely by landscape D (M=7.70, SD=1.98). Landscape E (M=7.34, SD=2.14) ranked in the middle, followed by A

(M=6.94, SD=2.02) and lastly C (M=6.85, SD=1.98). There were however, some variations relating to age and gender.

3.6.8.4.1 Influence of gender on attractiveness ratings

Overall, the order of landscape preference was very similar between the females and males (Table 3.6.8.4.1.1). However, women chose Landscape D (High VQI) as the most attractive landscape followed by B (UQ VQI), while men chose B as the highest, followed by D (High VQI). This means that the women matched the order of the VQI ratings exactly whilst the men showed some variation. Women also rated all landscapes higher than men and this difference was statistically significant ($p<0.05$) for all of the landscapes except landscape A which was the LQ VQI site.

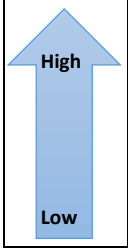
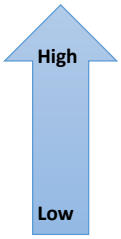
Ranking	Female (n=468)		**Landscape:**		Male (n=499)		Ranking
	Mean	SD			Mean	SD	
	8.06	1.90	**D (High)**	**B (UQ)**	7.53	2.16	
	8.01	1.80	**B (UQ)**	**D (High)**	7.35	1.99	
	7.68	1.93	**E (Med)**	**E (Med)**	7.01	2.22	
	7.05	2.03	**A (LQ)**	**A (LQ)**	6.82	1.99	
	7.03	1.95	**C (Low)**	**C (Low)**	6.71	1.96	

Table 3.6.8.4.1.1 *The order of landscape preference assessed by gender, means and standard deviation (SD) reported with the associated order of the five GMEP landscapes.*

3.6.8.4.2 Influence of age on attractiveness ratings

To facilitate analysis, respondents were grouped into four age categories; '29 and under', '30 – 44', '45 – 59' and '60 and above'– the mean rating scores and SD for these groups are shown in Table 3.6.8.4.2.1. While bearing in mind the different numbers of respondents in each age group, a number of interesting observations can be made: While younger (under 24) and older (55+) individuals score landscape B as most attractive followed by landscape D, individuals generally between 25 and 54 select Landscape D as more attractive (followed by landscape B). The mean rating scores indicate that age groups '29 and over', '45 – 59' and '60 and above' ranked the five landscaped in the same order - B (UQ) as highest, followed by D (High), E (Med), A (LQ), and C (Low) as lowest. Age group '30 – 44' ranked landscapes in the following order - D (High) as highest followed by B (UQ), E (Med), C (Low) and A (LQ) as last. Also, the mean scores indicate that younger age groups ('29 and over' and '30 – 44') gave lower overall ratings than the older groups ('45 – 59' and '60 and above'). Generally, younger respondents (in '29 and under' and '30 – 44') tended to rate landscapes A, B, C and E lower than the older respondents, particularly 45 to 59 year olds and those who are 60 and over.

Landscape	**29 and under (N = 120)**		**30 - 44 (N = 275)**		**45 - 59 (N = 302)**		**60 and over (N = 270)**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
A (LQ)	6.29	1.717	6.43	1.91	7.02	1.992	7.61	2.044
B (UQ)	**7.31**	2.329	7.63	1.829	**7.74**	2.015	**8.13**	1.969
C (Low)	6.27	1.969	6.64	1.92	6.97	1.774	7.24	2.145
D (Max)	7.29	2.056	**7.83**	1.854	7.65	1.881	7.77	2.15
E (Med)	7.28	1.991	7.09	2.158	7.32	2.001	7.63	2.211

Table 3.6.8.4.2.1 *Mean and standard deviation for four age groups, highest ranked landscapes are highlighted in* ***bold*** *in each case.*

3.6.8.4.3 Influence of nationality on overall preference ratings

The mean scores show no difference in the order of preference between individuals who considered themselves Welsh, English, or British. The few Scottish respondents however scored landscape D as highest, followed by landscapes B, A, C and lastly E. When the results were explored statistically, the only significant differences found were for Landscape A (LQ) and Landscape E (Median). For landscape A (LQ), the mean score of the 'Welsh' group (M=7.22, SD=2.056) was significantly different from the 'British' (M=6.79, SD=1.983) and 'other' nationalities (M=6.48, SD=2.062). For landscape E (Med), the mean score of the 'Welsh' group (M=7.73, SD=2.021) significantly different from the 'English' (M=7.09, SD=2.288), 'British' (M=7.10, SD=2.095) and 'Other' (M=6.90, SD=2.112) groups. Respondents who considered themselves Welsh rated these two landscapes higher than those considering themselves British, English or other nationality (Table 3.6.8.4.3.1)

Landscape:	**Groups compared (only significant comparisons shown)**			**Mean Difference**	***p***
A (LQ)	Welsh	vs	British	0.429	0.014
		vs	Other	0.739	0.027
E (Med)	Welsh	vs	English	0.637	0.024
		vs	British	0.629	0.000
		vs	Other	0.831	0.015

Table 3.6.8.4.3.1 *Comparisons between landscape assessments per nationality, results from Post-hoc comparisons using the Tukey HSD test.*

3.6.8.4.4 Influence of childhood home on overall preference ratings

The mean rating scores of respondents who grew in a village, town, or large town or city ranked the five landscapes in the same order - B (UQ) received the highest scores, followed by D (High), E (Med), A (LQ), and lastly landscape C (Low) (Table 3.6.8.4.4.1). Those who grew up in a small town ranked landscape D (High) highest, followed by B (UQ), E (Med), C (Low) and landscape A (LQ) as lowest. People who grew up in a village gave generally higher scores for each of the landscapes than those who grew up in a town or city.

Grew up in:	**Village (N=342)**		**Small town (N=220)**		**Town (N=212)**		**Large town or city (N=196)**	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
A (LQ)	7.17	2.112	6.70	1.94	6.77	1.951	6.98	1.962
B (UQ)	**7.99**	1.869	7.35	2.167	**7.67**	2.176	**7.97**	1.81
C (Low)	7.01	2.027	6.72	1.848	6.68	1.991	6.88	2.014
D (High)	7.80	2.012	**7.49**	2.048	7.66	1.92	7.80	1.912
E (Med)	7.55	2.173	7.15	2.002	7.01	2.216	7.52	1.968

Table 3.6.8.4.4.1 *The order of landscape preference according to where respondents grew up or spent their childhood. Highest ranked landscapes are highlighted in bold.*

Post-hoc comparisons using the Tukey HSD and Games Howell tests indicated significant differences in the mean scores of the following groups (Table 3.6.8.4.4.2): For landscape A (LQ), the mean score of those who grew up in a village group (M=7.15, SD=2.107) was significantly different from those who grew up in a small town (M=6.68, SD=1.938). For landscape B (UQ), the mean score of those who grew up in a small town (M=7.35, SD=2.164) was significantly different from those who grew up in a village (M=7.97, SD=1.868) or large town or city (M=7.97, SD=1.810). Lastly, for landscape E (Med), the mean score of those who grew up in a village (M=7.54, SD=2.170) significantly differed from those who grew up in a town (M=7.01, SD=2.112).

Landscape	Groups compared (only significant comparisons shown)			Mean Difference	*p*
A (LQ)	Village	vs	Small town	0.468	0.037
B (UQ)	Small town	vs	Village	-0.623	0.003
		vs	Large town or city	-0.619	0.009
E (Med)	Village	vs	Town	0.524	0.023

Table 3.6.8.4.4.2 *Post-hoc comparisons using the Tukey HSD test for landscapes A and E, and the Games Howell test for landscape B (because data could not meet the homogeneity of variances assumption) of the type of settlement that the respondents grew up in or spent their childhood.*

When these data are analysed statistically, the results in Table 3.6.8.4.4.2 indicate that respondents who up in a village tended to rate landscapes A, B and E higher than those who grew up in a small town (for A and B) or a town (for E). Also, those who grew up in a large town or city rated landscape B higher than those from a small town.

3.6.8.4.5 Influence of current home on overall preference ratings

Mean scores indicate that respondents currently living in a village or small town rated landscape B (UQ) as highest followed closely by D (High), while those living in a town, large town or city rated D (High) as highest followed by B (UQ) (Table 3.6.8.4.5.1). All groups (except those living in a small town) rated landscape C (Low) as least attractive, with A (LQ) as second to last. Conversely, residents from small towns chose A (LQ) as least attractive, with C (Low) as second to last.

	Village (N=443)		Small town (N=219)		Town (N=150)		Large town or city (N=153)	
	M	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
A (LQ)	7.02	2.038	6.82	2.021	6.8	2.027	6.92	1.914
B (UQ)	**7.84**	2.03	**7.8**	2.023	7.59	1.943	7.62	1.984
C (Low)	7.00	1.968	6.89	1.97	6.63	1.916	6.63	2.025
D (High)	7.63	2.095	7.79	1.976	**7.61**	1.745	**7.8**	1.864
E (Med)	7.36	2.143	7.44	2.103	7.05	2.069	7.36	2.073

Table 3.6.8.4.5.1*: The order of landscape preference according to where respondents currently live. Highest ranked landscapes are highlighted in bold.*

3.6.8.5 Heatmap Results (Areas found most attractive)

Figure 3.6.8.5.1 shows the five landscapes (ordered from high VQI value (Landscape D) to low VQI value (Landscape C)) overlaid with a 'heatmap' of area(s) respondents favoured most. **Landscape D** shows a very clear single focus of preference on the beach area, and while few respondents selected the sea (close to the shore), there are virtually no selections anywhere else. For **landscape B** (UQ VQI value) three areas of preference can be discerned; the most prominent one being on the flowering heather, followed by a distinct focus on the livestock (sheep) and a more diffuse selection of the hillside. For **landscape E**, again three areas of focus can be seen; two prominent focal points are on the fields on a hill in the far distance and deciduous trees on the side of a hill in the middle distance. A third area of lower selection can also be noted on the fields and hedgerows on the right hand side in the middle distance. Six/seven areas of selection can be noted on **landscape A** (LQ VQI). The two most prominent ones are on grass fields and hedgerows on the hill in the top middle of the image and on the valley in the far distance, followed by one on the prominent hedgerow and another on the river. Another two (fainter) areas of selection can also be seen on the smaller valleys/hills. A seventh, but a very faint, area of selection can be seen on the farm buildings (top left hand corner). Approximately seven areas of selection can be seen on **landscape C** (lowest VQI value). The three most prominent areas are on deciduous trees/woodland, farm/house buildings and the

fields/hedgerows in the distance. Other three prominent areas of selection are on the fields and hedgerows.

In general, higher VQI landscapes tended to show fewer, but more concentrated, areas of preference. The number of areas increased in landscapes with lower VQI values, but these 'hot spots' tended to be more diffuse (less concentrated) than the high VQI landscape areas of preference.

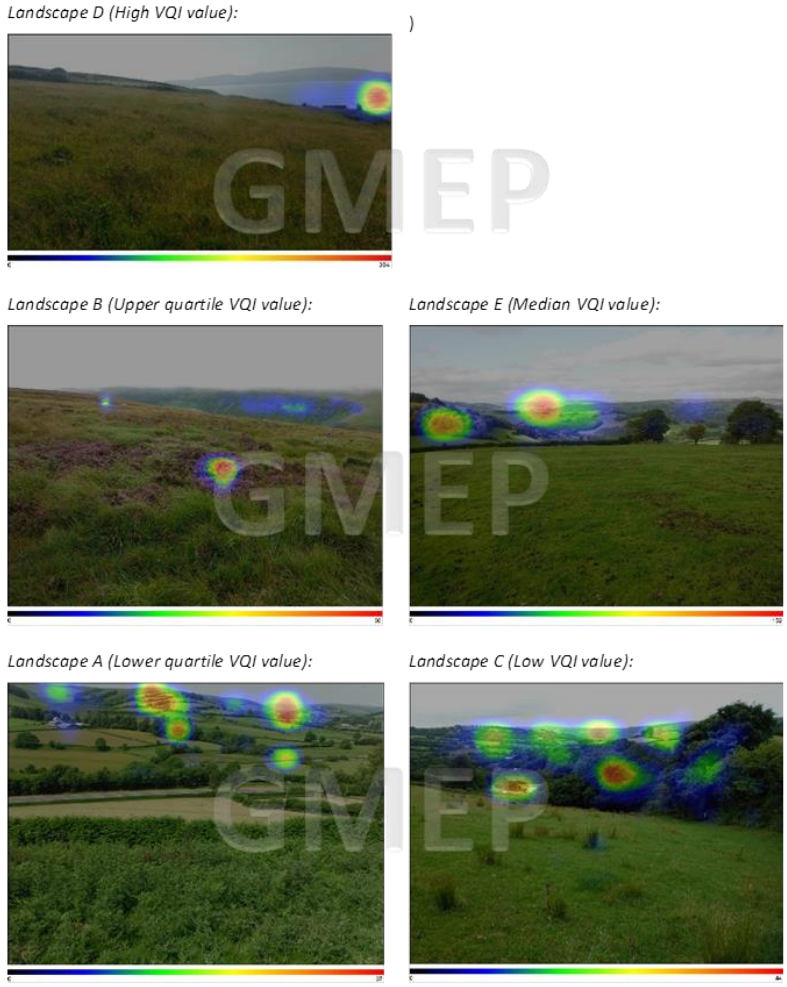


Figure 3.6.8.5.1 *Heatmaps showing the density of chosen locations from 976 respondent choices for each of the five landscape photographs.*

3.6.8.6 Feature Preference Results

Six landscape photographs were selected with particular landscape components that feature in the VQI and which can have either a positive or negative effect on it. These components were surrounded by a frame and respondents were asked to select whether they liked, disliked or had no opinion (neutral). The results for each feature in the six landscapes are presented below and it should be noted that respondents were not able to see the descriptions of the features in frames:

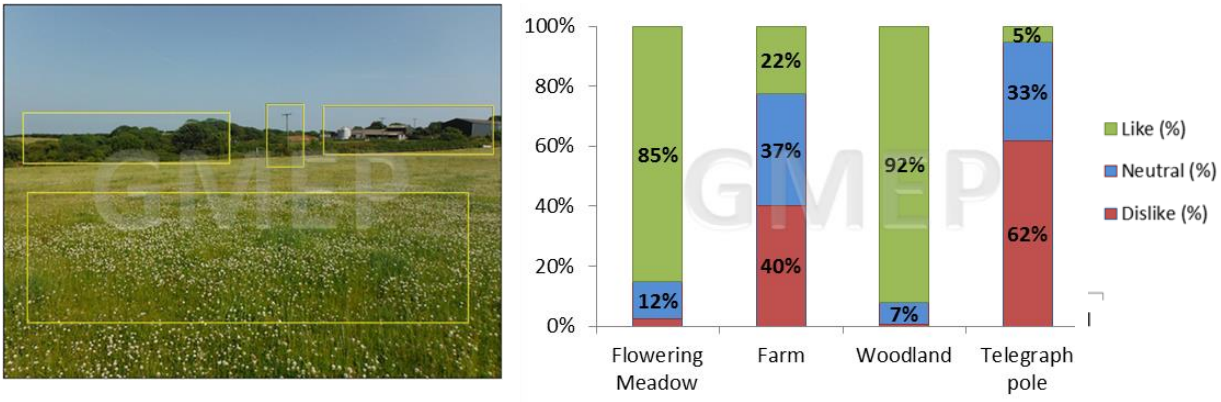


Figure 3.6.8.6.1 Landscape 1: *The two more 'natural' features of the flowering meadow and the woodlands were liked by the majority of respondents (85% and 92% respectively). The telegraph pole was mostly disliked – two thirds (62%) of responded disliked it and a third marked it as 'neutral' (33%). The farm buildings were also disliked, although by a smaller proportion of respondents (40%), which is similar to the number (37%) of people who marked it as a neutral feature. Only a fifth (22%) of respondents liked the farm.*

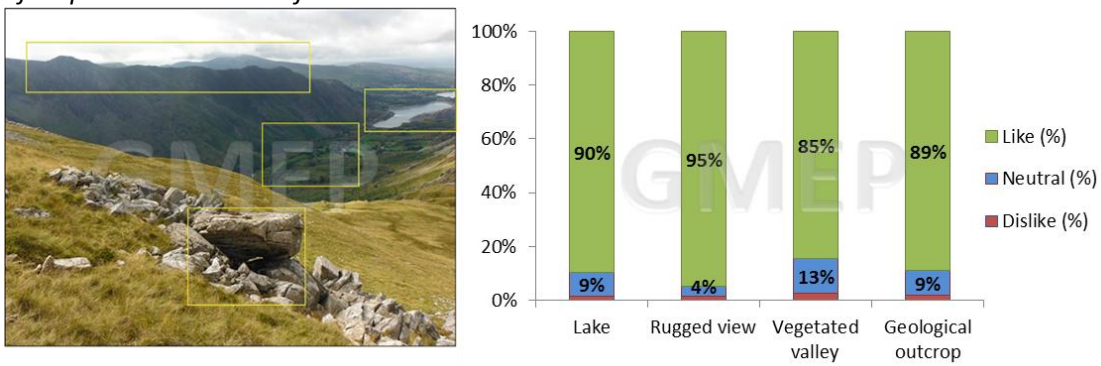


Figure 3.6.8.6.2: Landscape 2: *This appeared to be the most favoured of the six landscape images as all four of the framed features were liked by the majority of respondents.*

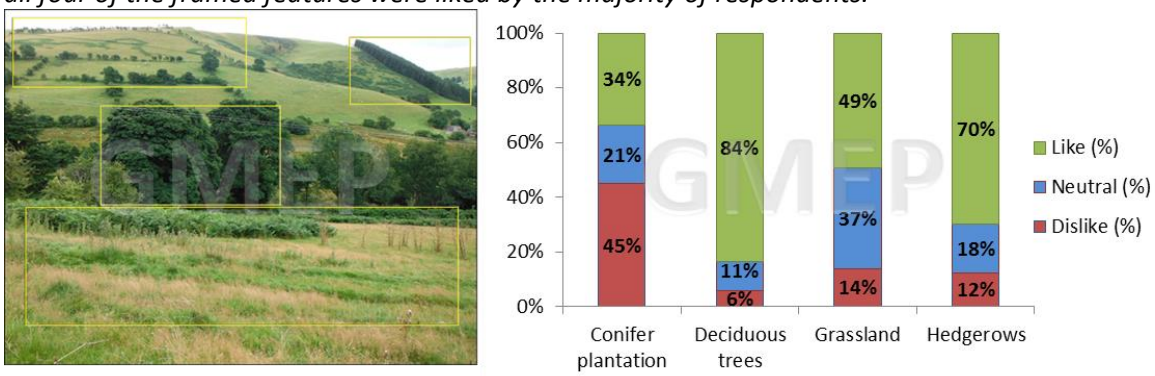


Figure 3.6.8.6.3 Landscape 3: *Deciduous trees were the most liked of the four features in this landscape followed by the hedgerows. Just under half of respondents said they liked the grassland at the forefront, with the rest marking either as 'neutral' (37%) or disliking it (14%). The opinion regarding the conifer plantation is less clear cut – while the larger proportion (45%) of respondents disliked it, over a third (34%) also liked it with a fifth (21%) marking it as 'neutral'.*

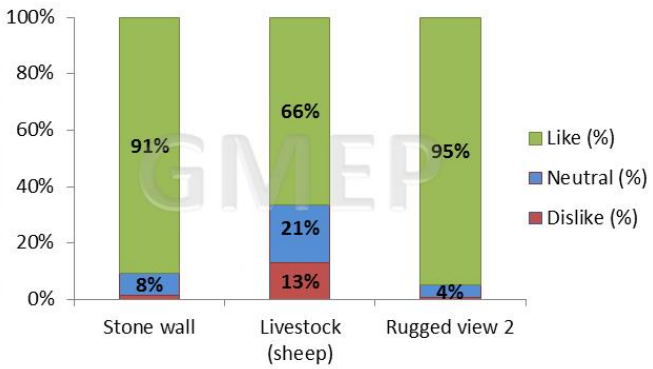


Figure 3.6.8.6.4 Landscape 4: *All of the features in this landscape were liked by the majority of respondents. Livestock (sheep) was liked slightly less (by 66%) of the respondents than the other two features – the stone wall and 'rugged view', which were liked by 91% and 95% of respondents respectively.*

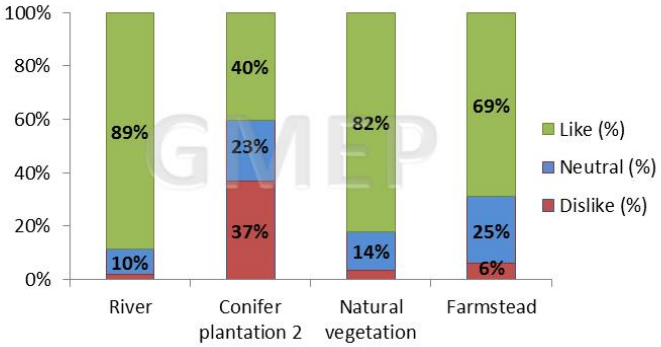
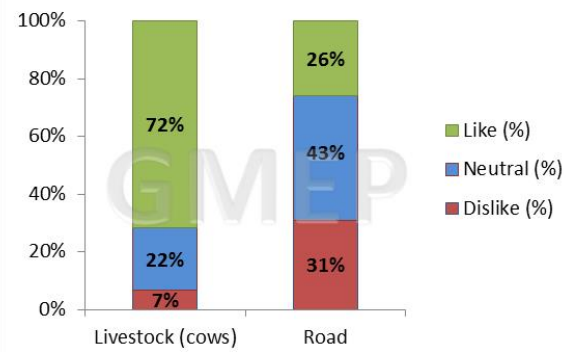


Figure 3.6.8.6.5 Landscape 5: *As in landscape 1, the more 'natural' features of the river and natural vegetation were liked by the majority of the respondents (89% and 82% respectively). Also, the overall preference for the conifer plantation was less clear cut with 40% respondents liking it and 37% disliking it. The slightly higher percentage of people liking the conifers in this image may be due to the plantation looking less prominent and better blended into the hillside than it is in landscape 1. The building labelled as farmstead was liked by 69% of the respondents – much more than the farm building in landscape 1. This is perhaps due to buildings in landscape 1 looking more 'industrial' (e.g. presence of silos, large cowsheds) than the building by the river in landscape 5.*



Landscape 3.6.8.6.6 Landscape 6**:** *The majority (72%) of respondents liked the livestock (cows). Opinion regarding the road was less definitive: while a third (31%) disliked the road and over a quarter (25%) liked it, most respondents (43%) marked it as 'neutral'.*

3.6.9 What is the condition of historic features in the GMEP survey?

Wales has a rich and distinctive historic environment that is revealed through its historic landscape character (fields, moors, lanes, settlements) and through its unique archaeological sites and material remains from previous industrial activity. There are currently 3 UNESCO World Heritage Sites,

30,000 listed buildings and over 4,000 Scheduled Ancient Monuments in Wales which are protected by law. These historic features are widely used in the promotion of Wales and are a key motivator for many visitors. It has been estimated that the historic environment supports over 30,000 jobs and in 2009 contributed approximately £840 million to the wider economy. The historic environment also creates social benefits for residents of Wales, including opportunities for leisure, volunteering and learning. As such maintaining these historical features in good physical condition is necessary as they play a key role in contributing to wider landscape values.

A range of designated features were present within the first and second year GMEP 1km survey squares including 23 Scheduled Ancient Monuments (SAM), and 107 Listed Buildings. In addition to the designated historic sites of Wales, there are a large number of important non-designated features within the landscape. These sites are documented by the four Welsh Archaeological Trusts which collate and continue to update the Historic Environment Features (HEF) dataset. The HEF dataset records the location and known information about these non-designated historic features. Together with the designated sites such as the Scheduled Ancient Monuments and listed buildings, these smaller features contribute to the overall historic and cultural value of a landscape. Existing datasets provide information on the location of historic features present within Wales. GMEP is providing an insight into the condition of those features within the GMEP 1km survey squares, the pressures they currently face and eventually will indicate how this changes over time.
With the 150 GMEP 1km survey squares of the first and second year survey, it has been possible to survey around 120 historic features. The most common types of feature were buildings (including houses and cottages), ponds and quarries.

An assessment of condition shows that 8% were judged to be in excellent condition at the time of survey and 35% were seen to be sound with minor defects. However, 33% were assessed to be showing major signs of deterioration while a further 7% were seen to have significant damage (Figure 3.6.9.1)

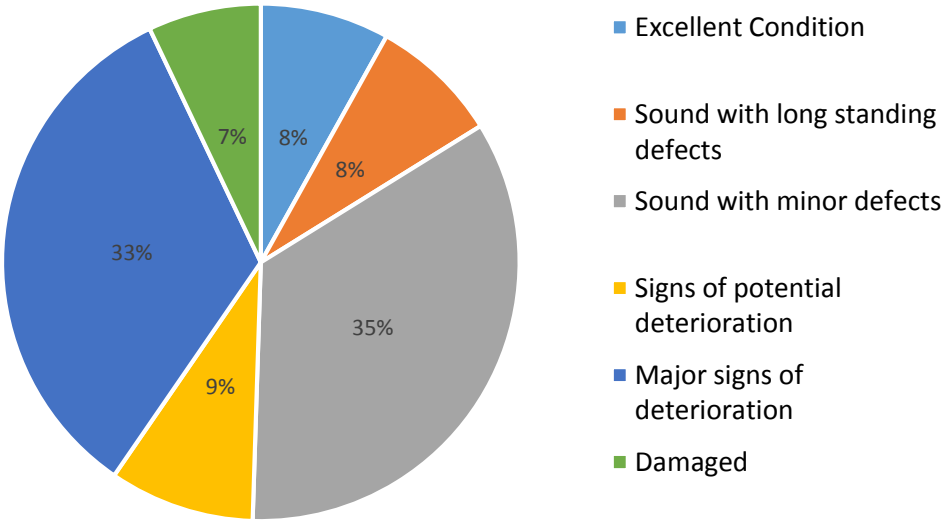


Figure 3.6.9.1 *Condition of Historic Environment Features (HEF's) from years 1 and 2 of GMEP 1km survey squares.*

Vegetation was the most prevalent threat (including scrub, bracken, brambles and rushes), with potential to not only visually obscure but also physically damage historic features Stock threats were also relatively frequent (including poaching, erosion and stock wear) while agricultural (for example surface tyre tracks, dumping, ploughing, drainage and pasture improvement) and other general

threats (including natural decay, vandalism, development, flytipping) were less common. (Figure 3.6.9.2)

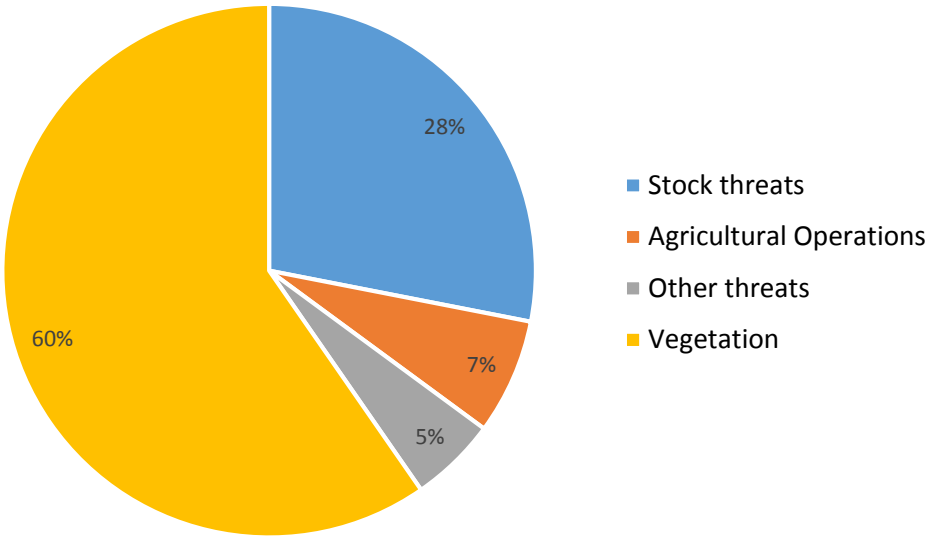


Figure 3.6.9.2 *Threats to Historic Environment Features (HEF's) or years1 and 2 of GMEP 1km survey squares.*

Non-designated historic features are common throughout all landscapes in Wales. On the whole, these features are found on private land so the long-term care of these cultural assets is frequently entrusted to individual landowners. Sometimes these features face neglect or suffer damage through lack of appropriate knowledge and management. Glastir provides funding to landowners to protect historic features through land use management such as switching from arable cropping to grass pasture or managing erosion by controlling stock better with fencing. In addition, payments are available to help manage scrub which is a particular problem on some historic sites. This type of active management has potentially positive impacts on visual landscape quality, where sightlines are clear, historic features can be seen and recognised as such by the general public.

3.7 Future Plans

- The repeat Wales Farm Practice Survey (WFPS) will be run in Year 4 (led by ADAS). It will generate important information from different cohorts of farmers (in and out of previous and current environmental stewardship schemes). The WFPS will generate data from which model estimates of the effectiveness of Glastir options to meet targets, e.g. for C sequestration, GHG emissions, water quality, woodland areas and biodiversity, can be adjusted for levels of uptake, thus making estimates more robust. We will seek opportunity to add key questions to the WFPS, which will improve the evidence base, and hence evaluation of the effectiveness of Glastir to meet its desired outcomes.
- We will return to the farms receiving Glastir Efficiency Grants (GEGs), which were C footprinted in 2014 to evaluate baseline GHG emissions and C sequestration. The repeated footprints will allow us to assess the effects of the GEGs on GHG emissions and C sequestration.
- Complete spatial disaggregation of the VQI for the 2nd year sites (n = 90) and finish a sensitivity analysis of the impact of different component weightings on the landscape weightings.
- Evaluate the impact of the three different scales of VQI data (250m, 1km, 3km).
- Explore the possibility of deriving a simplified VQI at the 1km scale for the whole of Wales.

- Analyse the detailed VQI data for these 150 sites, in particular to explore the quality of the landscape that is visually accessible to the general public by combining the results of the viewshed analysis with the VQI.
- Undertake a comparison of the outputs of the VQI with the landscape / sensory layers of the LANDMAP dataset.
- To begin the next stage of the landscape preference work. The GMEP photographic preference survey will enter a second phase where the public will be questioned about the impact of landscape changes promoted by the Glastir programme. A range of landscape photographs are currently being prepared to illustrate changes in the visual appearance of landscapes which may result from changed management.

Figure 3.7.1 *Examples of landscape photograph manipulations being prepared for the second phase of the GMEP PPS, the top row shows the landscapes currently, the bottom shows a range of landscape changes. (L to R) – with / without species rich grasslands; with / without stream and heather in flower; with / without hedges and woodlands.*